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A

NARRATIVE OF THE BUILDING

AND

A DESCRIPTION of the CONSTRUCTION

OF THE

EDYSTONE LIGHTHOUSE

WITH STONE:

80877

TO WHICH IS SUBJOINED,

AN APPENDIX, giving some Account of the LIGHTHOUSE on the SPURN POINT,

BUILT UPON A SAND.

BY JOHN SMEATON, *CIVIL ENGINEER*, F.R.S.

S-a-6

A B C

The MORNING after A STORM at S.W.

See § C. M. M. 301. and Technical Reference.

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LONDON:

PRINTED FOR THE AUTHOR, BY H. HUGHS:

SOLD BY G. NICOL,

BOOKSELLER TO HIS MAJESTY, PALL-MALL. 1791.

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TO THE

KING.

SIR,

FROM the ambition natural to man, all authors are deſirous, that their works ſhould be placed in the moſt favourable point of view. This motive alone would have urged me to ſolicit permiſſion to lay mine at the feet of my Sovereign; a Sovereign whoſe reign has been marked by the moſt rapid and diſtinguiſhed progreſs, in the arts, in commerce, and in the moſt ſublime as well as the moſt uſeful diſcoveries, altogether ariſing from YOUR MAJESTY's immediate protection and encouragement.

To be allowed to approach YOUR MAJESTY, and mix my tribute with others of ſo much higher importance, is a moſt flattering diſtinction. It is further my particular felicity, that the tribute I offer is of ſuch a nature as to accord with the ſcope of YOUR MAJESTY's private ſtudies.

The very cloſe manner in which the model of the Edyſtone Lighthouſe was examined by YOUR MAJESTY, ſoon after the building itſelf was completed, has left the moſt laſting impreſſion upon my mind, of the critical knowledge which YOUR

MAJESTY has acquired in the art of building; and the earneſt attention YOUR MAJESTY was then pleaſed to beſtow upon the ſubject, has emboldened me, at this diſtant period, to preſent it once more to Your conſideration.

It certainly requires an apology, that I have not more early acquitted myſelf of a work, that then ſeemed to engage YOUR MAJESTY's curioſity; the delay, however, as it has given me time to mature my thoughts, and has afforded proof of the ſtability of the ſtructure, may poſſibly render the book more worthy of acceptance: and it will be a further excuſe, that I can with truth ſay, I have ever ſince been employed in works, tending to the immediate benefit of YOUR MAJESTY's ſubjects; and indeed ſo unremittingly, that it is not without the greateſt exertion, that I am enabled, even now, to complete the publication.

I have it not in my power to preſent YOUR MAJESTY with a fine piece of writing, or of drawing; neither literature, nor the fine arts, having been much the objects of my ſtudy; but I humbly ſubmit to YOUR MAJESTY, a plain account of the conſtruction of a plain and ſimple building, that has nevertheleſs been acknowledged to be, in itſelf, curious, difficult, and uſeful; and as ſuch, I truſt, worthy of obſervation.

I have the honour to be,

SIR,

YOUR MAJESTY'S

Moſt dutiful ſubject,

and moſt obedient ſervant,

J. SMEATON.

PREFACE.

HAVING in ſome part or other of the following work, delivered the whole of what I would wiſh to ſay relative to the building, the hiſtory, and the deſcription of the *Edyſtone Lighthouſe*, I have little to offer by way of *Preface*, but what regards myſelf; or, my reader.

WHEN I re-commenced the compoſition of this work, in the year 1784; as I had then written ſeveral eſſays in the *Philoſophical Tranſactions*, in which I had been happy enough to make myſelf underſtood; I did not ſuppoſe it a matter of difficulty to give a diſtinct account of the progreſs and ſtructure of the *Edyſtone Lighthouſe*. I conſidered the account of every operation as a ſeparate eſſay; and conceived, that by joining them all together, I ſhould produce the book I meant to write. The motive to this undertaking will be found fully explained, in the latter part of the following Introduction; but the time it has taken, and the difficulties I have met with, have been, beyond all compariſon, greater than I expected.

THE *Introduction* was the eſſay with which I began; but this Preface being written after every conſtituent part of the work is gone through, I now find reaſon to change my firſt opinion, and am convinced, that to write a book, *tolerably* well, is not a light or an eaſy matter; for, as I have proceeded in this work, I have been leſs ſatisfied with the execution. In truth I have found much more difficulty in *writing*, than I did in *building*; as well as a greater length of time, and application of mind, to be required. I am indeed now older by 35 years, than I was when I firſt entered upon the enterprize; and therefore my faculties are leſs active and vigorous; but when I conſider that I have been employed full ſeven years, at every opportunity, in forwarding this book; having all the *original draughts* and materials to go upon; and that the production of theſe original materials, as well as the building itſelf, were diſpatched in half that time, I am almoſt tempted to ſubſcribe to the ſentiment adopted by Mr. POPE, that

"*Nature's chief Maſterpiece is writing well.*"——ROSCOMMON.

It is true that I have not been bred to *literature*, but it is equally true, that I was no more bred to *mechanicks*; we muſt therefore conclude that the ſame mind, has, in reality, a much greater facility in ſome ſubjects, than in others. How I am to ſucceed as a writer, is yet to be tried, and I ſhall readily ſubmit to the deciſion of the impartial *Public*. I can ſay with great truth, that I have taken much pains, and have left nothing undone, that appeared neceſſary to the full information of my reader upon the ſubject: and I hope, that however I may be defective otherwiſe, I have not fallen ſhort of an *explanation*, to thoſe whoſe leiſure, and patience, may give them leave to go regularly through the *detail*.

AS it is not a kind of work, that I could expect to find intereſting to many readers, I have printed but a ſmall edition in point of number; which renders it neceſſary to lay a heavier *tax* upon the *curioſity* of thoſe, who may be inclined to acquaint themſelves with the ſubject, than I could have wiſhed; at the ſame time, if the whole edition were ſold, it will a good deal fall ſhort of reimburſing my expences. Could I have publiſhed within four or five years of the completion of the Lighthouſe, the performance was then ſo much talked of, that I ſhould certainly have ventured to have printed a conſiderable impreſſion; but the novelty having yearly worn off, down to the preſent time, the expectation muſt now be rated very low; eſpecially if it be conſidered, that moſt part of my readers were then unborn: and, the greateſt real praiſe of the edifice, being *that nothing has happened to it*, nothing has occurred to keep the talk of it alive. The public curioſity, therefore, will be with more difficulty excited afreſh.

PERHAPS

PERHAPS I ought to make an apology for the largeneſs and fineneſs of my paper, as an article apparently enhancing the expence.——When I have ſeen a ſet of fine prints, produced with great labour and coſt, ſpoilt as *repreſentative pictures*, by being folded into a book, I could not but much regret it: and, the expedient of binding up the prints into a ſeparate book, while the *letter-preſs* matter is of a different ſize, I can only look upon as the neceſſary choice of two *evils*: for, I ſuppoſe it muſt be unhandy, and diſagreeable, to have the book upon one ſhelf, and the prints belonging to it on another. On this account, I intended from the beginning, to bring my prints within the compaſs of half a ſheet of imperial paper, and to have the letter-preſs work of the ſame ſize *, though the paper ſhould be coarſe.——I therefore made choice of a ſample of an ordinary paper of the imperial ſize, and engaged my friend Mr. WHATMAN to make me the quantity; but he, willing to ſhew himſelf a patron of the work, gave me a paper of the beſt fabric, at the ſame price I muſt have paid for the coarſe. To Mr. WHATMAN therefore my reader is obliged for the ſuperior goodneſs of the paper.——I do not however mean to paſs the ſuppoſition upon my reader, that the prints, I either meant, or have been able, to procure, are of that *delicacy* as in themſelves to demand all the attention I have had towards them. They are in reality little more than *geometrical lines*, drawn to explain *geometrical* and *mechanical* ſubjects. If any of them puts on the appearance of any thing further, it is to render it more *explanatory* and *deſcriptive*. They are in reality not meant as *pictures*: but yet, if a right line or circle, is drawn upon paper, it will appear a right line or circle, if the paper is *flat*; but let that piece of flat paper be folded into one, two, or more *angles*, the natural appearance of the figures is deſtroyed; and figures, that are in themſelves complex, are rendered ſtill more ſo. By this treatment, good prints are in reality ſpoilt, and bad ones rendered ſtill worſe. I am therefore rather ſurprized, that the learned have not much attended to this matter.

AS I ſpeak, and even write a *provincial language*, and, as I have already mentioned, was not bred to letters, I am greatly obliged to my friends in the country †, for peruſing and abundantly correcting my manuſcript: and laſt of all, to my friend Dr. BLAGDEN, who has been ſo obliging as to overlook the greateſt part of the *printed proofs*, with much advantage to the work. I ſay the greateſt part; as in juſtice to him, I muſt obſerve, I was obliged to ſend ſeveral of the ſheets to the preſs, without his ſeeing them. Whenever therefore a more than ordinary deficiency occurs in point of diction, my reader may conclude that ſheet never went to Dr. BLAGDEN.

IF I am aſked why, being ſo ſlenderly equipped as a writer, I ſet about it at all; and did not wholly commit it to ſome other perſon? My anſwer is, that I conſider this, as of the nature of a *commentary*; and that in an executive matter of *art*, the artiſt muſt write for himſelf; as he only can feel the force of his ſubject, ſo as to give it energy. I do not apprehend it to be of the *nature* of a commentary that the ſtyle ſhould be poliſhed; only that it ſhould explain the ſubject, in the moſt *eaſy* and *familiar* manner. If I have failed in this laſt reſpect, I have fallen ſhort of my hopes and wiſhes.——It is poſſible ſome diſcordancies may be met with on a ſtrict peruſal, notwithſtanding the care and pains I have beſtowed.——As it is, I commit it to its fate; having no preſage it will be uſed worſe than it deſerves.

* One of my plates, indeed, ſomewhat exceeds the *imperial* in ſize; but that was not the caſe, when it was engraven, in the year 1762: which ſeems to ſhew, that the ſize of this paper is ſomewhat leſſened ſince that time.

† Mr. WALTON, formerly my *colleague* in the *Derwentwater* Receiverſhip: and after him the Reverend Mr. MICHELL, well known to the public.

SOME things being mentioned as relative to the *preſent* time, that would now properly refer to the *paſt*, it may be of uſe to the reader to know that, from unavoidable hindrances, this work has been in a courſe of printing ever ſince the year 1786.

Since the working off the Table of Contents, the following *Errata* have occurred:

Page 168, l. 37, 38,	*for*	N° 12, 14, and 16,	*read* N° 12, and 15.
175, 17,		(§ 19)	(§ 17, and 21.)
197, 26, col. 2,		14½ miles,	14 miles 1 furlong.

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* The Numbers to which an *Aſteriſk* is prefixed, have been by miſtake repeated; the *Page* is therefore added.

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CHAP. I. *Containing the proceedings from the destruction of Mr.* Rudyerd's *Lighthouse in December* 1755, *to Mr.* Smeaton's *departure from* London *to* Plymouth, *in March* 1756.

§. 69. The Proprietors having the Remainder of a Term of more than *half a Century*, strenuously apply themselves towards re-building. *Difficulties* arose and stated. An *Act* to empower Mrs. *Hasselegger* to sell part of her property.—Three eighth Shares represented by the *Weston*s. A fortunate Circumstance.—Considered it not as a Work for a general undertaker in the building way; but for some one of a natural *mechanic* genius.

§. * 60. P. 38. Mr. Weston considered the *Royal Society* as likely to furnish or recommend a proper person.—Applied to Lord *Macclesfield*, then President; who recommended the Author. Then in the Country, and unknown to Mr. *Weston*.—Pointed out a friend to write to him.—The Author wrote to by Mr. *B. Wilson*, that he was made choice of to rebuild the *Edystone Lighthouse*. The Author conceiving this Building to have been of Stone, could not imagine it could be *totally* destroyed by fire.—Desired further information. Answered, that it was a *total demolition*; and he was *absolutely chosen* to this work.

* 61. P. 39. Returns to *London*. An interview with Mr. *Weston*; *papers*, *plans*, and *models* of the late Structure *explained* by Mr. Weston.—Great *bias* in favour of the *old building*. A question suggested. Answered satisfactorily.

* 62. P. 39. The *Plans* and *Models* being *sent* to the Author, were attentively considered. Not *sufficient* to make out the *precise plan* of any of the preceding Architects. Had been compiled from occasional observations.—Hence led to consider those *preconceptions* the Author had formed, of its being a *Stone Structure*. An *interview* desired with the *Body* of the *proprietors* upon a *leading* question.

* 63. P. 40. The *Author* states the *advantages* of a *Stone building*. The *proprietors* the *certainty* of *success* in one of the *same* structure as the last. Universally believed the *safety* of the late Building was owing to its *Compliancy*.—The objections answered; and reduced to a *simple Question*.—Determined in a satisfactory manner.

* 64. P. 41. The Author's *reasoning*, on the difference in structure of *Stone* and *Wood*. An *Enlargement* of the *base* very eligible.

* 65. P. 42. The figure of the *Bole* of an *Oak* furnished an *idea*. *Reasoning* upon its *figure*. The *Column* of greatest *Stability*.—References to a *figure*.

* 66. P. 42. *Bond* of the *Stone* to the *Rock*, and to one another.—*Cramping* considered. Objections. Of great Consequence, by all possible means, to *save time* upon the *Rock*.—*Dovetailing* considered. *Sparingly* practised in *Masonry*. An idea, taken from a method sometimes practised, of fixing the *Kirbs* of the *walking paths* in *London Streets*.—Sketch of the method. An Example from *Belidor* of a sort of *upright dovetail* Stones, in the floor of the great Sluice at *Cherbourg*.—The idea of *Dovetailing* matured.

* 67. P. 43. *Fair Section* made out for a *Stone* Building.—The *sloping* of the *Rock advantageous* to the strength of the foundation.

* 68. P. 44. Another *interview* proposed with the *Proprietors*.—On exhibiting those *original Sketches*, they declared their entire *satisfaction*; and proposed they might be shewn to the *proper Boards*: and, if *they approved*, to prepare for *execution*.—In the Author's opinion, matters not *ripe* for this. He ought to see the Rock, and take real *Dimensions*, to enable him to make a *working model*. Approved by the Proprietors: and that it should have the *same* general *form* and Conveniencies as the last.

CHAP. II. *Containing an Account of the Proceedings and Occurrences on Mr.* Smeaton's *first Journey to* Plymouth, *in the Spring of the Year* 1756.

§. * 69. P. 45. Arrival at *Plymouth*. Interview with Mr. *Jessop*, who appeared likely to answer the Character the Author had had of him.—Openings of his proposal of a *stone building*, and Mr. *Jessop's Objections*.—The late House in a state of *decay* by the *worm*.

70. Wind not favourable to go out to the Rock. Waited on Commissioner *Rogers*. Directs Artificers to make *Tools* for *trial* of the Rock.

71. The 2d of April *sailed* out *near* the Rock. Viewed it, but could not land.

72. 2d *Voyage*, April the 5th. Landed and staid 2 ½ hours. General Observations.—Traces of *Winstanley's Irons*.—Observations on *Rudyerd's* Iron *Branches* and *Steps*.—Upper part of the Rock *damaged* by the *fire*.—Tried the *workableness* of the *Rock*.

73. No appearance of *Impracticability* of a *stone building*. A more safe and *certain* way of *landing* highly *desirable*.—Often difficult, after a vessel had delivered her Cargo, to get out again from the *Gut*.—An *attending vessel* in company, necessary.

74. April 9th. Wind favourable, went out at Midnight, but obliged to return.—No prospect of success at sea till the 14th.—Looked out for a *Work-yard*. Its necessary *properties*.—No place to be had in or about *Plymouth*.—*Emparcombe* the work-yard used by *Rudyerd*; *not suitable* to a stone building.—*Millbay* the most *likely* situation.

75. Excursion to see the *Moorstone* at *Hingstone Downs*. *Manner* of *working* it.—*Price*.—Rendered low by the *regularity* of its *splitting*.

76. April 14th. The 4th *Voyage* proved unfavourable to land. An hard gale; *bore away* to the Harbour of *Fowey*.—This Harbour described.—*Mistakes* concerning it.—*Fowey*, or *Foy Harbour* the *Key* of the *Edystone* service.

77. Went to *Lanlivery*. Found *Walter Tredrewen*, who wrought *Moorstone* for *Rudyerd*. Described the manner. The Moorstone here different from that of Hingstone Downs, and more suitable to the Author's purpose. Manner of its carriage by Land.—Walking Paths of *Westminster Bridge* chiefly from hence.

78. Blew hard till 19th. Went out the 5th *time* for Edystone. A calm;

* These Numbers to which an Asterisk is prefixed, and the Page added, have been also, by mistake repeated.

anchored

anchored 4 miles from it, succeeded by an hard gale, and with difficulty regained Plymouth.—Hence the *Expediency* of a *ſtore veſſel* to be moored near the Rock appeared to the Author. Approved by Mr. Jeſſop, who recommended a particular conſtruction for that purpoſe. If a *floating Light* was *moored there*, it might anſwer both purpoſes.

§. 79. A piece of *Portland Stone* cut out of the *King's Dock*, that had been *perforated* by a kind of ſmall *ſhell-fiſh*; like wood with the Worms.—Pieces of *Marble* Rock found to be perforated in a *ſimilar manner*. *Portland* Stone *not* eligible for the *outſide* of the Lower works of the Edyſtone.—This *ſtone* likely to laſt longer than *Wood*; but the Author's ideas not confined to *an age* or *two*.—Thoſe *Perforations* chiefly confined to *low Water* Mark. Unneceſſary to run any *riſque*, *Mewſtone* being *undeniable*.

80. April 22. The 6th *Voyage*. *Landed* on the Rock before 6 Morn. Staid till Noon. Operations interrupted by the *Ground Swell*. Relanded at 2, and ſtaid till 9 at Night.—Boat laid in the *Gut* all Night. Next Morn landed at 5, and went on till 11. Obliged to retreat by a *Ground Swell*, which was *ſucceeded* by an *hard gale* of wind. Obſervations on its effects till 5; then returned.

81. *Account* of the *Operations* on the Rock. *Inſtrument* for taking *certain points* of the Rock.—Conſtruction and uſe of the Inſtrument.—*Improvements* in this Apparatus.—Thirty-five *primary points* herewith determined. Manner in which *many more* were *deduced* from thoſe *originals*. The *meaſures* hence deduced *laid down* to a *ſcale*.

82. The 7th *Voyage* unſucceſsful in landing. *Boat away* to *Falmouth*.—*Excurſion* from thence to *Conſtantine*. Interview with Mr. *Box* a Moorſtone worker there.—A capital workman, but had chiefly applied to ſmall works.—Author determined to uſe *Portland Stone* for the *inſide* works; and on account of the difficulties of *carriage*, to *reduce* the ſize firſt intended of the Granite Pieces.—Returned by way of the Edyſtone; not landing, returned to Plymouth.

83. Report of *40 ſail prize ſhips* in Plymouth, to be *ſunk* near the *Edyſtone*.—The weather appearing favourable, the Author proceeded to ſea; but this *Attempt* rendered *fruitleſs*, by a change of weather. On return waited on the *Commiſſioner*; and *remonſtrated* againſt this meaſure: he propoſed to conſult *Adm. Moſtyn*, who commanded at *Plymouth*. Delays dangerous. The Author wrote to a proprietor, who applied to the *Admiralty* to give other orders. Next day ſaw *Adm. Moſtyn*, who then *relieved* him from his *Apprehenſions*.

84. Weather bad till May 14. The Author in this interval turned his thoughts on the ſubject of *facilitating* the *Landing*; and on the proper *mode* of carrying on the *works* upon the *Rock*.—An *expedient* deſcribed by Mr. *Jeſſop*.—Mr. *Jeſſop* a man of *judgment*, but not of *invention*.—Approved the Author's plan. Subſtance of Letters to the Proprietors thereupon.

85. A ſtone building conſiſting of a *greater tonnage*, would take more time than if of wood. *Ineligible* to take a *greater time* in the whole than formerly. *Expedition* muſt therefore be procured by *Art*. The means pointed out.—Further means. A *ſtore veſſel* and *two ſets* of workmen.—Mode of *payment*, ſuch as to make it their *intereſt* to do their beſt.—Plan for carrying on the *works*, and management of the *workmen*.

86. May 11th, the 9th *Voyage* commenced. *Practicable*, but *hazardous*, to go into the *Gut*.—The Author conſiders how to remedy this inconvenience.—To *level* the *Sugar Loaf* Rock, in itſelf a *great work*. The uſe of *Tranſport Buoys* and a *Windlaſs* of a *new* contrivance * ſeemed applicable.—Approved by Mr. Jeſſop, who ſuggeſted Improvements.

87. Landed at 7 Morn, and ſtaid till 11; obliged to quit on account of rain; but the moſt material meaſures now obtained.

88. May 15th, the 10th *Voyage*, landed at 11¼M. Quitted at 2¼A. All obſervations now completed.

CHAP. III. *Containing tranſactions and occurrences during the Author's return from* Plymouth *to* London, *in May* 1756.

§. 89. The Author in his return to London viſited the quarries that were likely to furniſh *Freeſtone* to Plymouth.

90. The quarries at *Beare* in *Devonſhire*. Account thereof.

91. Viſited *Portland*. Recommended to Mr. *Roper*, Agent at Portland for . . . . *Tucker*, Eſq. of *Weymouth*.

92. Firſt object of Curioſity the *Portland Quarries*. Deſcription of the *Strata*.—The *Portland Cap*.—Manner of *working* the *Merchantable* Beds into *Blocks* for Sale.

93. Deſcription of the *Carriages* for the Stone, and method of uſing them.

94. The beſt *Freeſtone* to be had here, in any quantity, *rough ſcappelled*, but not *hewn*.

95. The *Pier* for Shipping adjoining to *Weymouth Road*.—Portland *Lighthouſes* viſited.—The *Strata* of this Iſland, various, and curious to the Naturaliſt. The moſt ſtriking *curioſity* to the Author was the *Portland Beach*. Renders it doubtful whether Portland is *properly* an *Iſland*. The *Beach* deſcribed.—Seemed to the Author not to have had its origin at a very remote period.—*Looſe* in its component parts, but *not ſhifting*; and reſts on a *Blue Clay*.

96. The Author not having met with a full account of the *Beach*, was willing to give ſuch a one, as the time employed on this viſit would allow; to excite the able Naturaliſt to a more full inveſtigation. A ſingularity obtains in the *manners* and *cuſtoms* of the *Portland Quarrymen*.

97. Settled with Mr. *Roper* and determined; the beſt mode would be to ſend *Moulds* to direct the *Scappelling*. Proceeded to view the *quarries* at *Purbeck*.

§. 98. The *Peninſula* commonly called the *Iſland* of *Purbeck*. *Corfe Caſtle*. The *Mortar* examined.

99. *Swanage* the principal town. The *quarries* viewed, and the *Strata* deſcribed.—Manner of working them. Strata of *Marble* raiſed here; ſuch as ſeen in many of our old *Cathedrals*. The *Paving Stone* from hence having for many years paſt ſupplied the *London Markets* wholly; now come at with *more difficulty*.

100. Strata called *Purbeck Portland*; quarries chiefly near *St. Alban's Head*. Manner of working, and qualities.—Departed from hence to *London*.

CHAP. IV. *Containing Tranſactions in* London, *after* the Author's *firſt Journey to* Plymouth.

§. 101. The Author attended the Proprietors. Account of Proceedings, as already related. The *leading Queſtion*, whether to rebuild with Stone entirely, or entirely with Timber; or partly with both. *Time*, a *principal* conſideration; that *ſtated* as relative to the different modes. An *Eſtimate* not practicable for the whole buſineſs; as the greateſt part of it would be widely open to Accidents. But whichever mode the proprietors choſe, the Author would endeavour to perform in the moſt ſubſtantial manner and at the leaſt poſſible expence.

102. *Unanimouſly* determined to *rebuild* with *Stone*; and in the very *beſt manner*. Reaſons for *waiving* their own *immediate intereſt*, in this determination.

103. The Author could not think himſelf juſtified in ſuppreſſing theſe Reaſons.

104. A *Stone Building* being *reſolved upon*; the Author was directed without loſs of time to prepare ſuch models and deſigns, as ſhould fully explain the propoſition to themſelves; and to thoſe Boards, they ſhould think it right to conſult. The *Time* and *Means* left to the Author.

105. *Good effect* of leaving him *unfettered*.—*Main object* to digeſt ſuch a *ſcheme* as ſhould go *progreſſively* on, according to opportunities, *without* derangements. With this view, having got ſufficient dimenſions, applied himſelf to the making an *accurate model* of the *Rock*. The time ſpent in a *mature digeſtion*, likely to be more than ſaved by avoiding *unneceſſary work*.—A firſt principle, to cut the *rock as little as could be helped*. For this end a ſecond *model* was neceſſary, to ſhew the manner of applying the new work thereto.—The Author determined to make both theſe *models* with his *own hands*.

106. His reaſons, for executing theſe models *himſelf*.—In other matters he availed himſelf of the hands of others. The *Purcheſe tackle*.

107. Viewed the *Neptune Buſs*, then fitting out for a *floating light*; chiefly to judge whether applicable as a *ſtore veſſel*, in the building ſervice. Deſcription of her.—Obſerved that if ſituated in a certain poſition ſhe might anſwer that double purpoſe.—*Declaration* of a Proprietor thereon.

108. The 13th July, the *two models* executed by the Author *exhibited to the Proprietors*.

109. Being fully conſidered, by the *Proprietors*, they declared their *entire approbation* of the whole of the Author's propoſition; and deſired him to explain the ſcheme to the *Admiralty* and *Trinity Houſe*; and adjourned their Meeting to the 17th, in expectation of thoſe Exhibitions being over.—The Board of *Admiralty* appointed the 15th, when the Author *attended*, and met with their *thorough approbation* of his ſcheme.—The 17th no appointment received from the Trinity Houſe; and the Seaſon faſt advancing, the Proprietors *determined* the Author ſhould ſet out for *Plymouth* on Monday morning the 19th of July.

110. During this abſence from Plymouth a conſtant *correſpondence* with Mr. *Jeſſop*. Final *Inſtructions* from the *Proprietors*.—One of the Proprietors delegated their Agent, in correſponding with the Author; and managing affairs.

111. The Author ſet out according to appointment for Plymouth.

112. The *original* Deſigns and Models, except that of the *Rock* as the Author *found* it, *differ* from the Building, as it now *ſtands executed*: yet is ſufficient to explain the mode of the Building. *Conciſe* Explanation of ſeveral *Plates*.

BOOK III.

Containing an Account of Proceedings from the Commencement *of the* Work *upon the* Rock *in* 1756, *to the beginning of the ſecond Seaſon in June* 1757.

CHAP. I. *Narrative of the* Progreſs *of the Work done upon the* Edyſtone, *from* (*the* Author's) *Arrival at* Plymouth *in July* 1756 *to the time of mooring the* Neptune Buſs.

§. 113. Arrival at *Plymouth*, 23d July 1756. Met Mr. *Roper* at *Dorcheſter*. Found *Hancock's* Sloop and other Veſſels properly prepared by Mr. *Jeſſop*.—*Neptune Buſs* arrived, and lay in *Stonehouſe Creek*. Not likely to be applied to the uſe intended. *Sloop* got ready for *temporary ſervice*. Weather now unſuitable, and had been ſo for ſome time paſt.

* Author finds, in 1789, that *windlaſſes* on this *principle* have been uſed in the *Severn Barges* time immemorial.

§. 114. Weather ſtill unfavourable till 3d Auguſt. Mr. *Thomas Richardſon* appointed *foreman* of one of the Companies. *William Hill* of the *ſea* appointed *foreman* of the other. Mr. *Joſſop*, general *aſſiſtant*. *Wages* ſettled.—Mr. *Delacombe* agreed with for Half an Acre of Ground for a *Work yard* at *Mill Bay*.

Mr. *Hareſtiſs* arrived at *Cleve* to the works.

115. The 3d Auguſt *firſt Company* went out. Wind became contrary; and the Author was rowed to the Rock in the *Yawl*, and began to fix the *Crane*, and *Lines* of the work. After which, obliged to return with the Sloop to *Cawſand Bay*.—The Weather becoming more unfavourable, returned to Plymouth.

116. The 5th, were out again, came to an anchor, and *attempted* to moor the Sloop, but obliged to *drift*. The Company *landed* and *worked* four hours with good effect.—The 6th, worked both Morning's and Evening's tide. Generally the whole of the work laid out.

117. Reaſons for not uſing *Gunpowder* in performing this work.

118. The 7th being *Saturday*, the *Companies changed* upon the *Rock*.—The *Lines* on the Rock *inſpected*. Diſtribution of the ſeamen.

119. Settled weather attended with *Land* and *Sea Breezes*. The advantage thereof.

120. The work purſued *without interruption* till the 15th of Auguſt.

121. *Cable* found greatly *damaged* by the *ſharpneſs* of the *Rocks* at bottom. Place of the *Moorings ſhifted*.

122. The 13th Auguſt, veſſel fitted out by the *Trinity Houſe* as a *Floating Light*, exhibited the ſame. The *ground cable* again *cut* by the Rocks. One third of the work of this Seaſon now *diſpatched*. *Extraordinary Wages* made laſt week, by the *favourable weather*. *Poſition* of the *Floating Light*. Judged two *miles* to the *weſtward* of the Rock. Of no *uſe* to the artificers, unleſs to ſhelter them when *driven weſtward*, by *diſtreſs of weather*.

123. Sunday the 15th, a *rough ſea* obliged the hands to *ſtop* their *Mooring*s and bring the ſloop into *Cawſand Bay*. Returned on Tueſday *Mooring*s and bring the ſloop into *Cawſand Bay*. Returned on Tueſday Morning, but weather ſtill unfavourable. This day the 1ſt *draughts* for ſtone Maſts, but weather ſtill unfavourable. This day the 1ſt *draughts* for ſtone ſent to *Portland*. This afternoon the *ſloop* came again into *Cawſand Bay*. Lay there till Thurſday. Then again went out, but obliged to return. *Companies* changed in *Cawſand Bay*.—*Hill*'s Company *attempted* to go out, but obliged to put back. Sunday got out; laid hold of the moorings, and landed; but after half an hour obliged to quit.—Next night the ſloop's *ground cable* being *again cut*, obliged to go into *Cawſand Bay*.

124. The Author next day received *order* from the *Proprietors* to make uſe of the *Neptune Boſs*. Adapted her to the ſervice with little alteration.—The 27th, wind and weather moderate, *Hill and Co.* again went out in the *Sloop*. The *Buoys* being gone, they came to an anchor. Enabled to make ſhort tides. The *Moorings recovered* by *ſweeping*. Sloop again moored. Auguſt 29th, *Boſs cleared* of unneceſſary ſtores, and made ready. Wind, though moderate, unfavourable for carrying out the Buſs. Richardſon's Company *turned out* in the Yawl and *changed* upon the Rock.

125. 31ſt. *Buſs brought out* of Stonehouſe Creek. Warped to one of the *King's Buoys* in *Hamoaze*. Sept. 1ſt, Wind not in favour, endeavoured to make a *Tack*, but the veſſel would *not ſtay*. Came to an anchor.—Next day wind fair; but being moderate, and the *Buſs* an *heavy Sailer*, made but little way. Came to an anchor in the evening 2 ¼ miles from the Rock. Diſpatched *ſharp tool*s to the *Company* at work.—Friday 3d, got the veſſel *out* and were aſſiſted by Richardſon's Company in *warping* her to her birth; *proceeded to moor*.

126. The chain *Moorings deſcribed*.—Mode of mooring as originally intended. A neceſſary *alteration* in the mode.

127. Manner of *laying down* the *Moorings* deſcribed.—*Safe completion* of this buſineſs.

128. September 4th. *Work examined*, and judged *one half*, for *this ſeaſon*, to be completed.—The *ſloop* brought home.

CHAP. II. *Sequel of the* Operations *upon the* Rock, *of the firſt Seaſon of* 1756.

§. 129. The Buſs being *ſatisfactorily moored*; nothing now to hinder but bad weather.—*Draughts* ſent to *Portland* for the *foundation* Courſes.

130. Companies worked *regular tides* from 27th Auguſt to 14th September. Manner of preparing *wooden moulds* for the exact cutting of the Stones.—*Moulds* neceſſary to every *different ſize* and ſhape of Stone.

131. A *Weſt Indies ſhip* and a *Man of War's Tender* ſaved from driving upon the N. E. rock.—Manner of *ſplitting Stones* by the *Key and Feather*. *Winſtanley's Chain* reſeated.

132. Sept. 14th and 15th, an hard Gale at S. W. The firſt ſince the Buſs was moored, and was found to ride perfectly eaſy. The work examined by the Author *and the ſtate of it deſcribed*.

133. Unſettled weather. Work further examined. *Difference* of *Level* of the *foundation Courſes*. The *Yawl* having *parted* her grapling rope, and *loſt* her *grapling* in endeavouring to weigh it; occaſioned the expediency of the *Transport Buoy*, before ſuggeſted, to be *put in uſe*.

134. The 2d Oct. an *hard gale* of wind brought *Richardſon* and Co. *home* in the *Yawl*, having no ſharp tools. Hill and Co. prevented going out.—The 4th, the *ſeamen wanting proviſions*, and the weather continuing bad, *came home* in the *little Yawl*, with an *Oar* for a *Maſt* and a *Blanket* for a *Sail*. This evening Hill and Co. got out.

135. The ſeaſon far advanced. The Author forms a ſcheme to avoid *weighing* the Buſs's *chain Moorings*.—Approved by Mr. *Joſſop*, who ſuggeſts Improvements.

136. The 15th, the *Great Yawl* broke *adrift* in a hard gale of wind.—Only 23 *boats* worked in *October*. Little wanting but *leveling*. —*Chocks* of the *Cable damaged* by the Rocks, and repaired.

137. Nothing to hinder the Commencement of *ſetting* the *ſtone foundation* next Seaſon. Richardſon ordered to return at the end of their week, though they were not relieved by the other Company. Inſtance of great *difference* of the *weather* at *Edyſtone* and at *Plymouth*. Both Buoys of the mooring anchors *broke looſe*.

§. 138. *Machinery*, &c. of the *Work-yard* got *ready* for uſe. Experiments on the *Strength* of the *Tackle*.

139. A better appearance of weather in November. *Hill*'s Company went out. The Author went off with a carpenter, &c. to make *wooden moulds* from the Rock. Prevented by weather. Having landed, reports the ſtate of the works.

140. The 12th Nov. the *Buoy Chain completed*. *Experiment* of its Strength. Edyſtone Boat ſent out with *Proviſion*; but returned without being able to get out. Attempted again the 15th without ſucceſs; and this evening the *Buſs arrived* in *Millbay*. Since Oct. 2, the work had amounted only to 38½ hours.

141. *Buſs*'s *Bottom* become very *foul*, was cleaned, and again prepared for Sea.

142. The Author with proper Aſſiſtants ſailed the 21ſt November. Retarded by an accident; and the ſlow ſailing of the Buſs even when clean.—*Bridle Cable* being *hard laid*, and ſtiff by the water, came in very tardily. Somewhat damaged by the Rocks. The 22d at 3 morning, the *Swivel* got *above water*; and the *Buoy Chain attached* thereto. The *fore lock* clinched by the Author.—Freſh of wind obliged the Edyſtone Boat to go home. Circumſtances hindered the *quitting* the *moorings* till 3 A.

143. The *wind* become *unfair* for *Plymouth*, ſteered for *Fowey*.—Night *dark* and ſtormy, *miſſed* the *Harbour*. *Breakers* ahead. By great Exertion the *veſſel got about*. Heaved down by ſtreſs of wind, *gunnel frequently under water*. Company in great *Jeopardy*. Concluded to ſtand out to Sea. *Eſcaped the Rocks*, but *ſplit* their Sails, the Main Sail excepted.

144. Tueſday, 23d, at break of Day, obliged to *cut* the only remaining *yawl adrift*. *Wore* the veſſel, and ſtood in for the Land; which ſaw about noon, and judged the *Lizard*. Diſcerned Land right ahead, which proved the *Land's End*, but upon the *Weather Bow*. Evening more *moderate*, bent *freſh ſails*, and made an *Attempt* to get into *Mounts Bay*.—*Stood off* the Land during the Night; and at Two on Wedneſday morning *wore* the veſſel. *Saw Land* ſoon after day-light, which proved the *Land's End*, ſtill more to *Windward* than the day before. Came to an *Anchor*. Wind freſh right from the Land. A *Conſultation* on Meaſures. *Reſolved* to attempt to make *Scilly*.

145. Saw a *veſſel* from the Eaſt, which *bore down* upon them, and proved to be the *White Hart* of *Pool*, bound for *Guinea*. Could get no relief from her; but learnt the Courſe for *Scilly*. Prepared for ſailing for thoſe Iſlands, very early the next morning.

146. Thurſday 25th, at two morning, began to *heave in* the *Cable*; while doing, the wind ceaſed, and a *breeze in favour* ſprang up, which enabled the Company to ſteer for *Plymouth*. At four on Friday morning *abreaſt* of *Rame Head*, and at ſix at an *Anchor* in *Plymouth Sound*.

147. The relation of the work of the Seaſon completed.—Concludes with the *commendation* of a *deſerving* ſeaman. *Safety* of the veſſel and Company, in the late Adventure, principally due to the activity and alertneſs of *John Bowden*.

CHAP. III. *Containing the Tranſactions of the* Winter *of* 1756, *and of the following* Spring 1757, *to the Commencement of the* Outwork *of the enſuing Seaſon.*

§. 148. The moſt intereſting *facts related*, without ſtrictly conforming to Time.—Mr. *William Tyrrel* choſen *foreman* of the *Work-yard*.

149. *General deſign* and *contrivance* of the *Work-yard* explained.—Project to uſe as *large Stones* as the *ſituation* and *ſervice* would admit.

150. *Modern Buildings* in general compoſed of *Stones* rather *ſmaller* than large. The Reaſon thereof. Advantages of large pieces.

151. The *ſize* of Stones moſt *proper* for the *Edyſtone* work pointed out. —*Stones* of a *Ton* and upwards, not to be managed in the *Work-yard* without *Machinery*; or an *increaſe* of *Labour*.—Reaſons for *trying* every *courſe* to its *neighbour*.

152. Veſſels arrived with *Stone* from *Portland* in *December* 1756. The *Maſons begun* to work. *Difficulty* in getting the *Moorſtone* brought home on account of its *ſize*. Diſpatched a *veſſel* from *Plymouth* with proper *Tackle*.

153. *Moorſtone* though hard yet *friable*, and difficult to bring to an *Arriſs*. Neceſſary to do the *principal part* of the work at *home*. *Mode* of *Agreement* for doing a certain part in the country. The *Prices* agreed for.—*Reaſons* for employing *more* than *one Contractor*.

154. Conſtruction of *additional veſſels* neceſſary for the ſervice of the enſuing year. The ſervice beſt performed by *ſmall veſſels*.—*Size* of *veſſels* pointed out.—The number.

155. *Yawls*: the *ſort* pointed out.—A large yawl purchaſed. The ſmaller made at *home*. Why to be *preferred* for the Edyſtone ſervice, to thoſe made at *Deal*. *Drawing* of a *Yawl* preſerved, and referred to; and the larger *Boats deſcribed*, which anſwered the ſervice.

156. The importance of obtaining *Cement*, the moſt *perfect* that it was poſſible to make. *Nothing* of the *reſinous* or *oily* kind could poſſibly *anſwer* in this ſituation. Only ſuch as would become *hard*, without being *ever dry*.

157. The Author reſolves to *winter* at *Plymouth*, and go through a courſe of *Experiments* on *Cements*.

158. A *Journey* to the *Weſt*, the ſpring of the year 1757. The *Church* of *Leſkeithiel* viewed, that had ſuffered much by *Lightning*.—Its *damages deſcribed*.

159. The Author went out to the Edyſtone to get the *Moulds* made of the *Work* upon the *Rock*. Viewed the work, but could not land.

The

The *Moorings* in good order.—Several other attempts; but could not land till 23d April. The *Moulds* then got in *part made*; but hindered *from proceeding* by a neglect of the carpenter. *Completed* on the 30th.

§. 160. The work of the Moulds for the foundation *rendered inconvenient* by being denied the use of the *public rooms*.

161. Much *hindrance* laft feafon by our *feamen* being frequently detained by the Men of War's cutters to *impreſs* Seamen. The Author ſuggeſts a *remedy*.

162. The *Veſſels* from *Portland* with *Stone* for the Edyſtone, detained by *fear of French privateers*; and an *order* from the *Admiralty* for a *Convoy* obtained thereupon.

163. The *Stone* in Millbay *Work-yard* being all *wrought up*, Maſons employed in quarrying *Marble* for *Cubes* for inlaying between the Courſes. The Tinners employed in *boring holes* through the Stones for *Trenailing* them down. 300 *Trenails* purchaſed.

164. A *Combination* among the workmen, and *William Hill*, one of the *foremen* of the Rock Companies, *diſcharged*.

165. The *premium* per *hour* given the laſt ſeaſon propoſed to be *reduced*; *agreed* to by the workmen.

166. The Commanding Officer of the *Fleet* at Portſmouth being applied to, for a *Convoy* for the Stone from *Portland*; regular *Anſwers* were received, yet *no Convoy* ever attended this ſervice.

167. *Five fathom* of large *Chain* for the Moorings arrived from London in May. *Prepared* to *begin* the *Work* of the *Seaſon*, as ſoon as weather permitted; but previous to the relation of it, the Author propoſes to give an *Account* of his Experiments on *Cement*.

CHAP. IV. *Containing* Experiments *to aſcertain a complete Compoſition for* Water Cements; *with their reſults.*

§. 168. The common *Tarras* Compoſition recognized. Some aſſertions of Workmen concerning Mortar *unſupported*.—*Saltwater* by them *diſapproved*.—The Author's reaſoning thereupon.

169. Enquiry into the effect of *Limes* being *imperfectly burnt*. *Great waſte* hereby in works at large; but did *not hinder* the Author's *Experiments*.

170. *Method* of making *Mortar* for trials.

171. *Common Lime* and Sand would not ſtand the *Water Teſt*.

Queſtion 1ſt. Concerning *Lime* from Stones of different *hardneſs*.—The *Inveſtigation*. Compariſon of *Chalk Lime* with that of *Plymouth marble*.

Queſt. 2d. Concerning the difference of *ſalt* and *freſh water* for making *Water Mortar*.—The *Inveſtigation*.

Queſt. 3d. Difference reſulting from different *qualities* of *Limeſtone*.—*Inveſtigation*. That of *Aberthaw* in *Wales* approved.

172. The *notion* of Workmen examined concerning *repeated beatings* of Mortar.

Queſt. 4th. If *tarras mortar* is better by *repeated beatings*. *Inveſtigation* with *Aberthaw* lime.

173. *Shell Lime* for water building examined.

174. *Plaſter* of *Paris* for water building examined.

175. Lime of *Bridiſtow* in *Devonſhire* examined.

176. *Chemical* examination of *Lime Stones* propoſed.

177. *Method* of the Chemical Analyſis of Lime Stones.

178. Trial of *White Chalk*, Plymouth *Marble*, and *Plaſter*. *Aberthaw* Lime Stone tried, and alſo *Bridiſtow*.

179. *Pure Limes* not the beſt for water building. The *beſt* generally contain *Clay*.

180. *Tarras*, its *properties* recounted, and not anſwerable where ſubject to become *dry*.

181. Another *property* of *Tarras unfavourable* for ſome uſes. *Terra Puzzolana* recommended by *Belidor*, and ſome *procured* for *trial*.

182. *Puzzolana tried* and approved; and *beſt* with *Aberthaw* lime.

183. The *beſt method* of making *Grout*, or liquid Mortar, *neceſſary* to be known; and propoſed to be examined.

184. *Inveſtigation* of the beſt method of making *Grout*.—*Plaſter* for this purpoſe tried and *rejected*.

185. Some *account* of *Tarras* and *Puzzolana*.—Method of the *Preparation* of *Tarras* in *Holland* for uſe.

186. *Puzzolana* deſcribed. In great quantities near *Mount Veſuvius*. That uſed for the Edyſtone from *Civita Vecchia*. That from Naples of an *inferior* quality.

187. *Tarras* and *Puzzolana* agreeing in ſeveral obvious properties, other *ſimilar ſubſtances* tried, but without ſucceſs.

188. Compoſition of *Edyſtone mortar* being determined; enquiry how and where to procure the Lime. That of *Watchet* recommended; to which place the author determined to take a *journey*.

189. *Journey* to *Watchet*. Saw *ſpecimens* of work done with that Lime, and that of *Aberthaw*.

190. *Watchet Pier* ſatisfactory as to the Mortar work. Manner in which the Strata of *Lyas* Stone lie. Thoſe uſed for burning into Lime are got from the *ſea ſhore*.—Then but *little demand* for this Lime, and the reaſon.—A quantity burnt to aſcertain the *bulk* and *weight*. The *mode* of *package* agreed upon and deſcribed.

191. *Blue Lyas* Stone of *Watchet* deſcribed; *White Lyas* analyſed. *Unfit* for water works.

192. Author propoſes an *Account* of what has *occurred* to him on this ſubject *ſince*.

Limes ſince examined.

193. That of *Barrow* in *Leiceſterſhire*.

194. *White Lyas* of *Somerſetſhire* compared with *Clunch* Lime of *Suſſex*; a ſpecies of *Chalk* deſcribed, containing *Clay*, and good for *Water building*. The Lime of *Darking* in *Surrey* eſteemed of the ſame kind.

§. 195. *Sutton* Lime of *Lancaſhire*. The Stone analyſed and deſcribed. Good for *Water building*.

196. *Gray Lime* of *Berryton* near *Peterſfield*, *Hampſhire*, a *Chalk* Lime containing *Clay*, like the Clunch. A *Water Lime*.—A *Water Lime* of the Chalk kind alſo near *Guildford*.

Blue Lyas Limeſtone at *Lyme* in *Dorſetſhire*, alſo eſteemed good *Water Lime*.—*Table* containing the *reſults* of Water Limeſtones *analyſed*.

197. Trials for a *ſucceedaneum* for *Tarras* or *Puzzolana*; Smith's *forge* ſcales found *equal* in quality, but not to be had in quantity.

198. *Minion* deſcribed. *Inferior* to *Puzzolana*.—A particular *Red Stone*, found *equal* to *forge Scales*, but could not find it in quantity.

199. Means of *increaſing the quantity* of good water Mortar.

200. The uſe of *Sand* in Mortar.

201. The proportion of increaſe *of bulk* of Mortar by different quantities of *ſand*.

202. Purſuit of the ſubject and introduction of *Pebbles*.

203. Trial of *Clay* in the Compoſition of Mortar, *hurtful*.

204. *Stones* naturally *flat-bedded* recommended for Water building.

205. *Flat backing* recommended in preference to *rough rubble*.

206. *Table* containing 20 Compoſitions of *Water Mortar* ſuited to different ſituations and circumſtances.

Obſervations on the Table——in ſeven different Heads.

BOOK IV.

An Account of the Proceedings of the Conſtruction *of the* Stone Work, *&c. upon the* Rock, *from the beginning to the finiſhing of the Building. With after occurrences.*

CHAP. I. *Containing an Account of the* Firſt Year's Building *upon the* Rock.

§. 207. 3d June, 1757, ſailed out of Plymouth Sound to *begin* the *work* of the *ſeaſon*. A *Difficulty* aroſe in getting up the *Moorings*. The manner of *obviating* it deſcribed.—Some *danger* attending this operation, was performed by the Author. The *Buſs* ſucceſsfully *moored*.

208. The *Fender Piles*, the *Shears*, and *Windlaſs*, and the *Tranſport Buoy* fixed.

209. The *firſt Stone* landed, got to place and fixed, Sunday the 12th June, 1757. Next day the *firſt Courſe completed*.

210. The 14th, the *ſecond Courſe begun*. A *freſh Gale* aroſe, obliging the Workmen to quit the Rock.—Things *ſecured* in the beſt manner poſſible. The *Gale increaſing*, impracticable to get out of the Gut; otherwiſe than by paſſing the *Sugar Loaf*. Yawls could not both *recover* the *Buſs*. The *Sea-horſe Yawl* made her way Weſtward to the *floating Light*.—An hard *ſtruggle* to the *light Yawl* to regain the *Buſs*.—Next morning the wind ſhifted; and the *Weſton*, obliged to *quit* the *Tranſport buoy* and get into Port. Afternoon the *Sea Horſe* Yawl got back in *ſafety*, from the floating Light.

211. The *Work proceeded* with. The 18th, hands again obliged *ſuddenly* to quit the Rock; and the Weſton to go into Port.—Several diſaſters deſcribed. The moſt conſiderable, the *loſs* of ſeveral *pieces* of *Stone*,—The Author *returned* to Plymouth, to expedite the forming *freſh ſtones* inſtead of thoſe loſt.—In carrying out the Stones, a *Gale of Wind* aroſe, obliging the veſſel to run into *Fowey harbour*.

212. The 30th June the IId *Courſe cloſed*; and the IIId begun.—A new *Tool contrived* for getting up *loſt Stones*.—Further progreſs reported.

213. Weather unfavourable.—Afternoon of the 5th July the work *renewed*; and purſued the next day. In the night the *Charming Sally of* Biddeford *wrecked* upon the Rocks, though the Weather was fine.

214. The 12th, the IIId *Courſe completed*, and the IVth begun. A ſudden violent *guſt of wind*, which as *ſuddenly ceaſed*.

215. Company *driven home* in bad weather for *want of proviſion*. An *alarming accident*; but without hurt to the people.—*Seamen preſſed* from a veſſel laden at *Portland* with *Stone* for the Edyſtone; but *diſcharged* by an order from the *Admiralty*.

216. Various interruptions; yet July 31, *Courſe* IVth *completed*, and the Vth begun. 5th Auguſt the work viſited and Vth *Courſe completed*. A *Cramp applied* to remedy an accidental defect. An *additional* Boat called *The Aſſiſtant*, *Samuel Medlley*, Maſter, brought out her *firſt Cargo* of Stone; a gale of wind aroſe, obliging her to ſeek an harbour. The *Edyſtone Boat* alſo came out. *Lime* and *Puzzolana* being *much wanted*, an *Expedient* contrived to get a caſk of each from on Board her. Courſe VI begun.

217. A *Meridian* traced on *Courſe* 6th. The Sea for the firſt time *never* having *waſhed over* the *work* at *high water*; this opportunity was taken to *repair* the *Pointings*. The method thereof; and obſervations.

218. The 9th of Aug. four veſſels arrived from Portland with ſtone. The 11th the VIth *Courſe* completing the baſement was *cloſed* in. *Recapitulation* of this part of the work.

219. Method of *ſetting and fixing* the *Stones* deſcribed.

220. Further deſcriptions.

221. Method of making the *mortar*. *Simple Machinery* uſed for *hoiſting* the ſtones.

222. Further detail of the manner of ſetting. Application of *Wooden Wedges*.

§. 303. The 5th Feb. ſtores landed. The Houſe examined by *Rouſden*; found nothing amiſs, except one pane of glaſs broke, as reported by Edwards. All well; but the South *Fender* Pile gone.

304. Soon after this, a *violent Storm* reported by *Admiral Boſcawen* to the *Admiralty*. *No Accounts* from Plymouth. The Author *wrote* to Mr *Jeffop*. *The Houſe reſpected*; but *no damage*, except to a part of the *Electrical Strap*. Lightkeepers well, and no Complaint.

305. In June 1761, Mr. *Weſton* wrote to the Author, informing that Mr. *Jeffop* was then dead; and Mr. *Richardſon* appointed *Surveyor* in his ſtead. As deſired, the Author in anſwer adviſed concerning the *renewal* of the *Painting*, and the *Electrical Strap*.

306. The *Strength* of the Building *doubted* by the Advocates for *Wood*, in caſe of a *Storm* of the *greateſt degree* of *violence*.—One of this kind happened in the year 1762. Mr. *Richardſon* being unequal to the relation; the effects were deſcribed by Dr. *Mudge*.—His *Letter* inſerted.

307. This Letter being wrote *immediately* after the *Storm*, and mentioning that the Lantern had *ſuffered nothing*, the Author deſired his *friend* to write a circumſtantial Account, after the Houſe had been *viſited*. Extract of Dr. Mudge's 2d Letter.—Nothing was diſturbed, except a ſmall matter of Putty from the Glaſs of the Lantern. Further deſcriptions of the Effects of the Storm.—Great *Damages* done in the *Harbour* and *Sound*.

308. The Author called into *Cornwall* in the year 1766. *Viſits* the Edyſtone.—Extract of his *Report* to the *Proprietors* of its *State* and *Condition*.

309. (*Erroneouſly printed* 308.) The Author called a ſecond time into *Cornwall* in 1777. *Inſpected* the Lighthouſe. Found things in *good Condition* as before reported.

310. The Author having a call to Plymouth Dock in 1787, again inſpects the Lighthouſe; *trigonometrical* operations for determining its diſtance from the Land.

311. The *Condition materially* and ſubſtantially the ſame as before, and particularly deſcribed. In the interval ſince 1777, Mr. *Richardſon dead*.

312. The *Iron Work* very *little injured*. Methods originally taken, with intention to prevent injury thereof from the ſalt water.—Deſcribed.

313. The luſtre of the gilding of the ball impaired, but not effaced.—Some *derangement* by late *Storms* to the *Lead Cover* of the *Balcony*. The Author apprized the Agent hereof, and how it ſhould be rectified.

314. *Reaſons* why *Lightkeepers* are *readily procured* to the Edyſtone, and ſtay *long* there. The Lighthouſe an *healthy* and *comfortable* habitation. Anecdote.

315. The inſcriptions upon the Building.

General Abſtract *of the progreſs of the work of the* Edyſtone Lighthouſe.

APPENDIX;

Containing an Account of the Eſtabliſhment of the preſent Lights *upon the* Spurn Point, *by direction of the Honourable Corporation of* Trinity Houſe, *Deptford Strond*, London.

§. 316. A *patent* granted to Mr. ANGELL in 1676, for continuing Lights on the *Spurn Point*, which he had erected at the requeſt of *Maſters* of Ships uſing the *Northern Trade*.—Before the year 1766, the Land had grown out to ſo great a length, that the *poſition* of the *Lights*, ſo far from being *uſeful*, were in many Caſes become *hurtful*. An Act for removing them paſſed in 1766, and the direction of the Building given to the *Corporation* of *Trinity Houſe* of *London*. Alſo to erect *temporary Lights*.

§. 317. The Author employed on this Occaſion by that Body. *Attended* the *Committee* at the *Spurn Point* in June 1766; who examined the ſituation, and fixed the Places of the *new Lighthouſes* and *temporary Lights*.—The Author's opinion requeſted concerning the *practicability* of building with *Brick*. Anſwered. *Committee* of opinion the new Buildings ſhould be placed as near the then preſent *Point* as poſſible. The *principle* of the *low Light Machine*, called a *Swape*, recommended for the *temporary Lights*.

318. The Author received directions from the *Trinity Houſe*, London, ſtating the ſituations and dimenſions of the *new Lighthouſes* and *temporary Lights*.—The *Order*.

319. Early in 1767, the Author produced a ſet of *Deſigns* for the *Lighthouſes* and *temporary Lights* to the Board of Trinity Houſe. Approved and paſſed the *Common Seal*. Delivered to *Lennard Thompſon*, Eſq', who proceeded to the *Execution* of the *temporary Lights*; which gave ſatisfaction.—Mr. *Thompſon* finding *difficulties* in the erection of the *Lighthouſes*, the erection devolved on the *Trinity Houſe*; and the 7th April 1770, Mr. *Taylor* of *York* became the *Contractor*.

320. May 1771, the Author appointed *Surveyor*. Since the year 1766, the Sea had conſiderably encroached upon the *Eaſtern Coaſt* of the *Spurn Point*. An *alteration* in the ſituation *propoſed* to the Board and agreed to. The piling increaſed.—The *Contractor interrupted* by the *Agents* of Mr. *Angell*. An *Amendment* of the *Act* found neceſſary, and the works ſtopped above a year. Latter end of 1772 the High Light begun; its ſituation alſo altered. The diſtance of the Lights ſtated.

321. In the year 1774, the Author remarked the *rate* at which the *Coaſt* was *wearing away*. *Danger* to the *Low Lighthouſe* thence apparent.

322. In 1776, a *great Storm* took away the entire *Site* of the *old Lighthouſe*. Brought down a part of the *circular* court *Wall* of the *Low Lighthouſe*. The method of ſupping further progreſs for the preſent.

323. To *defend* this Lighthouſe for a *permanency*, appeared to the Author impracticable. A repair of the breach recommended, and a temporary Defence as long as eaſily tenable. The preſent *High Light Machine* to be applied as a *Low Light*. *Approved* by the Board and executed.

324. This Accident did not materially retard the work.

325. The *Houſes* deſired to *be lighted before* the enſuing *Winter*. *Stone Coal* of *Yorkſhire* of the nature of *Kennel* recommended, and agreed to be tried.

326. The 5th Sept. 1776, the *Fires* were *kindled* with *Stone Coal*, and gave entire *Satisfaction*.—The *High Light Machine* immediately *removed* into the *line of Direction*. Its ſituation deſcribed: made moveable on Rollers.

327. In the firſt winter ſome *defects* at ſometimes ſhewed themſelves in the *Funnels* as to venting the Smoke. A *remedy* applied to the *Low Light*; afterwards applied to the *High Light*.—April 1777, the Author viſited the Spurn Point Lighthouſe, and certified the whole works contracted for by Mr. *Taylor* were *finiſhed*. The Lights had given entire *ſatisfaction*; and the *Court Wall* of the Low Light *ſtanding* in good Condition.

328. *Inconvenience* of the *Spurn Point* for want of *freſh water*. The Author ordered a Well to be ſunk towards the middle of the *Peninſula*. Reaſons for this procedure. Water obtained, which though not perfectly freſh, was but barely brackiſh.

329. The Author *viſited* the *Spurn Point* in 1786, took a *ſurvey* of it. The *Well* then *deſtroyed*, though it had been very *uſeful*. The *Iſthmus* deſcribed, over which the *Sea breaks* into the *Humber*.

330. The *Low Lighthouſe* being *demoliſhed* by the *ſea*, its uſe ſupplied by the temporary Light Machine.—*Manner* of its demolition.

331. An *unexpected* Circumſtance in the *appearance* of the Lights, ſurprized the Author, which he is at a loſs to account for.

332. The *Spurn Lights* uncommonly *brilliant*.

333. The *principle* of the *Air Draught* of this Lighthouſe explained.

Technical References to the Plates, page 193.

ERRATA.

Page.	Line.		FOR	READ
25	17	— —	§. 42 — — — — —	§. 48. N.B. This, with the numbers of the five following Sections, are by miſtake *repeated*; and would be well to be diſtinguiſhed by an * as *printed* in the table of Contents.
38	14	— —	60 — — — — —	70. N.B. This alſo, with the numbers of the nine following Sections, are by a ſimilar miſtake *repeated*; the * is therefore to be applied as in the Contents.
45	—	the running Title	FIRST PROCEEDINGS *towards* REBUILDING.	FIRST JOURNEY *to* PLYMOUTH. N.B. This running Title ſhould alſo have been prefixed to pages, 47, 49, and 51.
51	19	— —	— — — — —	78. This number wants prefixing to this Section.
68	48	laſt but two —	— — — — —	103. This number to be prefixed.
77	34	— —	31 of Auguſt — — — — —	5th of Auguſt.
90	19	— —	Thurſday — — — —	Tueſday.
101	—	the running Title	SEQUEL *of the Firſt Seaſon's* OUTWORK — —	*Tranſactions of the Firſt* WINTER.
180	34	— —	308 — — — —	309.

prepared.—The *Old Chain* carefully examined and *repaired*, and every neceſſary put on board the Buſs the 2d of July. Alſo the *new Chain*, which arrived this Evening from *London* by *Land*.

§. 266. 3d July, *went out* with the *Buſs*. Calms, &c. next day *completed* the *Mooring*. Poſition deſcribed.—Completed the Tranſport Buoy; the *Shears*, and Windlaſs fit up. The *work* examined by the Author and found all *ſound* and *firm*. Proceeded in ſetting the Floor. A large *Stone* found *wanting*. Probably *conſtrued* from the *Stone Room*. *Expedient* to ſupply its place.—July 5th, the Sea quiet. South *Fender Pile* fixed. The Rock quitted the firſt *time* for *want of work*. The Stone *arrived* in the Afternoon. Next morning the *firſt Floor completed*, and Center cleared.

267. *New Method* of *hoiſting* the Stones adapted to preſent Circumſtances deſcribed. The *Shelter procured* by the Completion of a *Room* gave an opportunity to leave the Tools and Materials on retiring.—Uncertain Weather. Working at Nights now diſcontinued.

268. Author went out to inſtruct Richardſon's Company in *loading* the *Chains* of the *ſecond Floor*. Meſſage from *Lord Edgecumbe* reſpecting the *Duke* of YORK.—Staid to ſee one of the *Chains loaded* in, and *returned* to *Plymouth*.

269. Next day ſhewed the *Model* of the Lighthouſe to Prince *Edward*, Duke of YORK. Attended his *Royal Highneſs* to *Mill Bay* to ſee the Works there; which met his approbation. Author rowed off in a ſix-oared barge, and landed at ſix the next morning. The *ſecond floor begun*.

270. July 21ſt, Second *floor finiſhed*. A room or Story built complete in 7 days. Proceeded to fit the Iron Work of the door hooks for *Leading*. *Block Tin* wanted for this uſe, *forgot* to be brought out. An *Expedient* for remedy. The method of *Leading* deſcribed.

271. A Seaman *miſſing* and recovered. The third *floor begun*, and *completed* the 29th. Two Stories built in 13 days.—Adverſe weather. The *Copper hall* completed at Plymouth.

272. Weather uncertain. The 6th Aug. the Author viſited the work, the XLVth or Cove Courſe in hand, and completed with its two Chains the 8th. This day an *uncommon rainbow*.—The 9th, the *Elliptical Center* for the Balcony floor ſet. The Weſton arrived with Stone, and in part delivered; but taken with a *ſudden freſh* of wind. *All hands* ordered to her *aſſiſtance*, had a *narrow eſcape*, and obliged to return to Plymouth. The *Balcony floor begun*; Wind freſh obliged all hands to quit. The Author returned to Plymouth.

273. Aug. 16. Weſton delivered. The *moveable Shears taken down*, and the Windlaſs fitted to hoiſt the ſmaller pieces through the *Manholes* or Hatchways.—The 17th the *main Column completed*. Its dimenſions.

274. *Balcony Rails* ſet up and *completed*. Proceeded in fixing the *Ports* for the Windows; and for temporarily ſecuring the *Man-hole* at top. The manner thereof deſcribed. Stone for the Lantern arrived and unloaded.—The 1ſt *Courſe* of the *Lantern* being *ſet*, the Author returned the 18th, leaving directions with Mr. Richardſon for that and the *Stairs* in the Well-hole.

275. The *Lantern* coming by *Land* from *London*, for Expedition's ſake, by the Carriers *inattention* was left at *Exeter*. Arrived the Evening of the 20th.—21ſt, the *Groundſel* of the Lantern applied and fitted to the Stone work. Progreſs reported to the *Trinity Houſe*.

276. The iron Ribs of the *Cupola* put upon the *Platform* to form the *Copper Roof* upon it. Method of the Conſtruction.—The 24th Sept. the *laſt Courſe* of the Stone work of the Lantern *completed*.

277. The 27th, Richardſon and his Company returned from the Edyſtone; having *completed* the *whole* of the *Stonework* the 26th.

278. Brief State of the Progreſs of the work. The Maſons and Tinners diſmiſſed; except ſome retained for other uſes.

279. Bad weather enſued.—Principal *Coppersmith* taken *ill*. *Trinity Houſe* deſire to know the day that a *Light* could *certainly* be exhibited in the Building. The Author's Anſwer.—Wanting the *principal Artificer*, the Author worked at the *Copper-work* of the Cupola. The *ſecond* Coppersmith taken ill, as the firſt had been. A *Workman requeſted* of another Maſter, but *refuſed*. Aſſiſted by the *Brazier* of the *Dock Yard*. The *Duke Man of War*, of 80 guns, drove by bad Weather into *Mill Bay*. *Grounded* on the ſoft mud, and got off *without damage*.

280. Directed by the *Corporation of Trinity Houſe* to fix the day of Lighting; ſo as to enable them to give *a Week's notice* by *Adverteſement*.

281. The 12th Sept. the Author ſailed with neceſſary Materials and Workmen for *completion* of the *Houſe*. Returned to expedite the remaining work.—*King's Yard Brazier* ſet to work on the *Copper funnels*.

282. The 15th, two Cargoes of materials landed. Workmen begun their reſpective operations.

283. Manner of *leading* the *Iron Groundſel* of the Lantern upon the Stone.

284. The 17th, the Copper *Cupola arrived*. The *Shears* and *Tackle* ſet up, and the *Cupola hoiſted*. The method of hoiſting deſcribed.—The 18th, the *Ball* arrived and ſcrewed on by the Author. The *Cabin bedſteads* completed. The *Author* and Mr. *Jeſſop* removed their *beds* from the Buſs to the *Houſe*. After that bad weather came on, and cut off all *communication* with the *Buſs*.

285. The 21ſt all the *Copper Saſh-frames* were got *fixed*: An *accident* to two of them in coming from *London*. How remedied. Artificers brought out, but could not be landed; a third *Coppersmith* taken *ill*. The diſtemper ſaid to be *epidemic*.

286. The 23d, Artificers landed. The *Glazing* of the Lantern *begun*: 24 *Iron Cramps* fixed in the Cupola by the Author, aſſiſted by a Maſon; the manner deſcribed.—*The Lead Covering completed*. Two more of the Artificers taken ill.

287. The 28th, *Joiners finiſhed* their work. The articles deſcribed; and the manner of fixing thereof.

288. Reaſons for the preſent *diſpoſition* of the *Rooms* to their reſpective uſes.

§. 289. Two *Chefts* of *Candles* arrived and other Stores. *Croſs Bars* brought out, and two Smiths to fix them; but being only half the number wanted, ſent back to make more. The Author proceeded to fix them. A *Painter deterred* from coming out, on account of the number taken ill. A Maſon employed in that work. Thoſe taken ill ſent home.—An *accident* to the *Author*, which if *unattended* would probably have *proved fatal*.

290. The 29th, the *Glazing completed*. The fixing the *Croſs Bars* proceeded with, and *their intention* deſcribed. The principal *Glazier* taken ill.

291. The 1ſt Oct. the diſpoſition of 8 pair of Croſs Bars deſcribed. The *Copper funnel* for the *Kitchen fire* was *completed* and tried. Alſo the *Tackle* for hoiſting the *Chandeliers*. *Tried* the *Lantern* by lighting *Candles* in the *day time*.—Two Lightkeepers brought out, but could not land. *Letters conveyed* into the Houſe by a *Keg*. Its contrivance and uſe deſcribed.

292. The *Conductor* for *Lightning* begun to be fixed. The manner of it. One of the propoſed Lightkeepers happened an accident; the other was intimidated, and refuſed to enter upon his Employ.

293. The 4th, *Stores*, *Water*, and Materials landed. Every thing *eſſential* to the *maintenance* of a *Light compleated*, and three of *the workmen agreed with* to keep the Light. An *expreſs* this day ſent from the *Edyſtone* to the Board of *Trinity Houſe*; giving *notice* for *Lighting* the 16th inſtant. Notice alſo given to the *Maſter* of the *floating Light*. The *ſick Glazier* and *diſabled* Lightkeeper *ſent back* to Plymouth.—A *great Sea* about the Rocks, a *ſenſible motion* in the Houſe. The *Rocks elaſtic*.—A *Ground Sea* mounting only to the Windows of the Kitchen, did not ſenſibly move the building. The *unhurt* Lightkeeper *apologized*, and came into the Houſe.—The 7th, the *Houſe* began to be *cleared*. The *Electrical Conductor completed*.

294. The 8th, two Boats arrived with Stores; and alſo the remainder of the *Croſs Bars*; too great a *Swell* for the *great Boats* to go into the Gut; their Stores put on Board the *Buſs*. Afterwards *removed* by the *Yawls* to the Houſe. *All* the *Stores* then intended got in, except four Caſks of Water. The *painting finiſhed*. The *Croſs Bars* all *fixed*. The *Clock* ſet up. Orders given to thoſe who were to keep the Lights.

295. The 9th Oct. at one in the Morning the Yawl brought the remaining four caſks of water, and began to remove the men, beds, tools, &c. *All* got on board the Buſs at four; and begun to *unmoor*. Found the *Eaſtern Chain* parted from the *Weſtern*. One of the *Links* of the Briſtle part of the Chain much *worn*. At four in the afternoon *all* the *Moorings* got *on board*, and with a fair Wind came to an anchor in *Plymouth Harbour*. Great Joy to thoſe on Board, being without loſs of *Life* or *Limb* to any one.

CHAP. IV. *Comprehending an Account of* Occurrences *ſubſequent to the bringing home the* Neptune Buſs *at the end of the Seaſon* 1759, *to the preſent time.*

§. 296. Few *Occurrences* in the laſt *thirty years*. The *Building* having remained in *good Condition*.—Bad weather after bringing in the Buſs, till Oct. 15th.—The Author then prepared to go out, to be preſent at the *Lighting*; but prevented by a reverſe of weather.

297. The 19th went out, landed, and found *all well*. The *Houſe lighted* on the 16th as directed; and every thing *obſerved well*. Seas in the late bad weather broke up high. Window ports ſhut to windward, and ſtuffed with Oakum. *Motion* of the *Houſe ſenſible*.—A further ſupply of coals, water, and ſmall ſtores, completed the Proviſion for *ſix months*. At the proprietors expence. Reaſons for this Proviſion.

298. A freſh Coat of Paint laid upon the Pillars of the Lantern to change their Colour. The reaſons thereof. Gave the inſide of the Cupola another Coat of Paint. The *Ventilation* of the *Lantern* proved *complete*. The *Floating Light* Veſſel *unmoored*, and went into Harbour. *Lightkeepers exerciſed* in their Buſineſs. The Author ſlept in one of the Cabin Beds. Noiſe of the Sea upon the Rocks remarkable in moderate weather.—Outſide painting finiſhed. An Iron *Hand-rail* fixed, and the rough ſteps in part cut in the Rock, completed. Coat of *Amber Varniſh* over the whole Painting omitted, till Spring. *Inſtructions* in writing from the *Proprietors* to the *Lightkeepers* framed and hung up. Exhorted to a diligent diſcharge of their Duty.

299. The 20th Oct. at Noon, ſailed for Plymouth. Wind contrary. Remarkable *appearance* of the *Light* at different *diſtances*. Accounted for.

300. Comparative *appearance* of the *Light* from the *Hoe* at *Plymouth*.

301. The *appearance* of the Lighthouſe from the *Hoe*, and the Seat breaking upon it in clear weather after a *Storm*. Combined with what the Author obſerved of the *gathering* and breaking of the *ſeas* upon the *Rocks*, when he was in the building, furniſhed the idea given in the *Frontiſpiece*. *Winſtanley's* account not exaggerated.

Occurrences after leaving Plymouth.

302. Stormy weather the remainder of the year 1759. The houſe viſited the 8th January 1760. Boat could not land. *Small Stores* conveyed into the Houſe by the *Keg*; and a letter conveyed to the Boat from *Henry Edwards*. Bad weather deſcribed. Put in great fear by the motion of the Houſe. Some ſmall damages.—The 10th again viſited, but could only land in the ſmall Boat. Seamen examined, but could not find the Mortar any where ſtarted.

§. 303. The

INTRODUCTION.

THE building of Watch Towers, now called *Lighthouſes*, for the direction of mariners, has doubtleſs, from the obvious utility thereof, had its riſe in the earlieſt ages; and in ſeveral inſtances has been the object of royal magnificence. None however was ſo much celebrated amongſt the ancients, as the *Pharos* of *Alexandria*, which has been accounted one of the ſeven wonders of the world. This famous tower was built by the PTOLEMIES kings of *Egypt* and ſucceſſors of ALEXANDER; it is ſuppoſed to have been finiſhed about 283 years before the Chriſtian era, that is, 2070 years ſince, and had the name of *PHAROS* from the iſland; upon a rock at the eaſtern end of which it was built, ſo that its walls were waſhed by the ſea. It was a ſquare edifice of a white hard ſtone, and was built in a ſtyle aſtoniſhingly ſuperb. According to the *Nubian* Geographer, a writer of the 12th century*, its height was 300 cubits; that is, 547 feet Engliſh meaſure; and a fire upon the top of it was conſtantly kept burning in the night, to light ſuch ſhips as ſailed near theſe dangerous coaſts, which are ſaid to be full of ſands, and ſhelves of rocks: and according to JOSEPHUS†, it could be ſeen at the diſtance of 300 *ſtadia*; that is 41½ *Engliſh* miles‡.

THE ſize of its baſe is not ſo well aſcertained; and indeed, as a Lighthouſe, it is not ſo material. A ſcholiaſt on LUCIAN takes upon him to aſſert, that it was a *ſtadium* in baſe! but this muſt have been a random ſtroke; as it would make the *Pharos* to have been greater in *bulk* than the great *Pyramid*, and therefore in that reſpect taking place of it as one of the *Wonders*. The ſame ſcholiaſt alſo aſſerts, that it could be ſeen at the diſtance of 100 miles; but this is quite impoſſible: for a tower 547 feet high, cannot be ſeen above 29 miles from the ſurface of the ſea; the reſt of the diſtance mentioned by JOSEPHUS, muſt be obtained by an elevation of the obſerver's eye above the ſea; which at the height of 111 feet, would enable him to gain a ſight of the fire upon the tower at the diſtance of 300 *ſtadia*: and an elevation of this kind we may very well ſuppoſe to be afforded from the tops of the maſts of their largeſt ſhips, eſpecially when lifted up upon the top of the waves of the ſea: whereas to ſee the fire at the diſtance of 100 miles would not only require the tower itſelf to be 560 *yards* in height; but the obſerver's eye to be elevated as much: a ſituation which does not ſeem afforded in this flat country.

JOSEPHUS in another place, ſpeaking of a magnificent building called the *Phaſaël* at *Jeruſalem*§, ſays it was 40 cubits in length and breadth, and about 90 cubits in height; and in its appearance reſembled the Tower upon the *Pharos*, which gave a light to thoſe who were ſailing to *Alexandria*: but in its *circuit* it was *much bigger*.——According to this account the Pharos could not be ſo much as 73 feet

* Geog. Nub. p. 94. *Paris* Latin Edit. 1619.

† Joſeph. Bell. Judaic. l. iv. ch. 11.

‡ It perhaps may not be amiſs to obſerve, that this reduction of the ancient meaſures to thoſe of *England*, is on the ſuppoſition that the *Egyptian* cubit, and which I underſtand was likewiſe the cubit uſed all over *Paleſtine*, *Aſia Minor*, &c. conſiſted of 21,888 inches nearly; as has been aſcertained from the pillar ſtill remaining on an iſland in the *Nile*, upon which the cubits ſuppoſed to be marked thereon 2000 years ago, are ſtill uſed for the original purpoſe of meaſuring the height of its inundations. For though the *Nilometer* now ſtanding is ſaid to have been erected in the 8th or 9th century by OSMAR, yet it is ſuppoſed to be an exact copy, in the upper part at leaſt, of the ancient one. And there is ſtill the leſs doubt that this was the true meaſure of the cubit, as this remarkable circumſtance has been noticed concerning it; that 400 of thoſe cubits making a *ſtadium*, 500 ſuch *ſtadia* make a degree of the meridian; agreeing with ſufficient exactneſs to the modern meaſures, to ſhew that this meaſure of the cubit was not a mere arbitrary aſſumption; but intended to be the 200,000th part of a degree: The baſe of the great *Pyramid*, being a *ſtadium* of this meaſure.

§ Joſeph. Bell. Jud. l. v. ch. 3.

in baſe, ſo that if the walls of it were 20 feet in thickneſs upon the ground, the clear hollow area it would contain could be only 33 feet ſquare; a ſpace in appearance (though there may be ſuppoſed rooms above each other) unequal to the containing a *garriſon*, that CÆSAR is ſaid to have thrown into it; that by commanding the narrow paſſage by it into one of the harbours, he ſecured by his ſhips the neceſſary ſupplies*.

It however is not difficult to conceive how in this article JOSEPHUS might be miſtaken, with regard to the relative bulk of the *Pharos*; for as he deſcribes the *Phaſaël*; viz. that after riſing a conſiderable part of its height upon a large baſe, it was contracted on all four ſides, by a broad platform with battlements round it; and that in the middle of this area there roſe up a ſecond building to a conſiderable height further; and as this deſcription entirely agrees with that which the *Nubian* Geographer gives of the Pharos; it is probable the reſemblance JOSEPHUS had in view, was chiefly this of the outward form: now if JOSEPHUS had been in uſe to ſee the *Phaſaël* in the neighbourhood of *Jeruſalem*, and the *Pharos* at a diſtance only; its height being in appearance loſt by diſtance, he would ſuppoſe the circuit of its baſe to be leſs, in proportion to the leſs *apparent* bulk of the Pharos; for, if the *Pharos* was in reality double the *Phaſaël* in bulk (as it probably might have been) yet as it was more than three times the height of the Phaſaël, JOSEPHUS would be liable to have been deceived in the compariſon of bulk or *circuit*; unleſs he had meaſured them both, or judged otherwiſe than from diſtant views.

THIS magnificent ſtructure, called even by CÆSAR *wonderful*, was the work of SOSTRATUS of *Cnidus*: and we are informed by PLINY†, that PTOLEMY very nobly permitted the name of the architect to be inſcribed upon the building; who accordingly cut the following inſcription upon the ſolid ſtone. SOSTRATUS THE CNIDIAN, THE SON OF DEXIPHANES, TO THE GODS PRESERVERS, FOR THE BENEFIT OF THOSE WHO USE THE SEA.

LUCIAN it ſeems has dropped a paſſage that has given a different turn to this buſineſs; which I ſhould not have mentioned, had it not been to reſcue the great architect from ſo invidious an aſperſion. LUCIAN, though a ſatiriſt, and joker of thoſe times, in the preſent caſe ſeems very grave; for in teaching his pupil the art of writing hiſtory, he bids him not to look out to pleaſe his cotemporaries, but to write for future times; and as an example bids him conſider what the *Cnidian* artiſt did‡. When he had finiſhed the work, he engraved his own name upon the ſtone, and ſmearing it over with mortar, he engraved upon that, the name of the king who then reigned; knowing that would happen, which did happen; that in a ſhort period of years, the letters falling off with the mortar, there would come to view the inſcription before ſet forth.

This account of the matter, though reſting upon the ſingle authority of LUCIAN, yet accords with that propenſity of human nature, to lower all great characters, ſo much better than that of PLINY, that it ſeems currently adopted by the modern compilers of ancient hiſtory§; and indeed the ſtory tells well enough in common converſation; yet as it appears to contain the evident marks of falſity, ariſing from the impracticability thereof, I have therefore no doubt but that PLINY's account is the truth.

Let us for a moment imagine the work to be done in modern *London* inſtead of ancient *Alexandria*: Can any one conceive it poſſible to get ſo many letters engraved of ſo large a ſize, and ſo deep, as to be ſuitable to ſo lofty a building; without its being known to ſeveral perſons concerned in the execution; and in conſequence ſoon getting to the ears of the king? Beſides, it would not be eaſy to make uſe of any plaſter or partial coating, the ſurface and colour of which could not be diſtinguiſhed from that of the ſtone, in thoſe critical examinations, that a public building of ſuch *eclat* would unavoidably undergo upon its firſt completion. In reality the king could have little doubt of his own name being celebrated to poſte-

* Cæſar Com. de Bell. Civ. l. iii. ſect. 112. † Plin. l. xxxvi. chap. 12. ‡ Lucian de ſcribend. hiſt. § 52.

§ See *Diſſertation* ſur le Phare d'*Alexandrie*, par MONTFAUCON. Acad. Royal des Inſcriptions et Belles Lettres. Vol. vi. p. 577, dated 7th Jan. 1721.

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rity as the finiſher of ſo great and uſeful a work; this being generally aſcribed to PTOLEMY PHILADELPHUS, the ſame who founded the *Alexandrian* Library.

IN reſpect to the expence of it, all ancient authors agree that it coſt 800 *talents*; but as modern authors differ very greatly in the value of thoſe talents; and we are furthermore at a loſs to judge what proportion ſubſiſted betwixt the value of *work*, and that of *money* in thoſe times, compared with our own; we are as much unable to compare its coſt, as we are its real bulk, with any of the ſtructures of modern times*.

AN edifice of ſo great a ſize, ſo well built, and of ſuch durable materials, as this building is deſcribed to have conſiſted of, one might very well have expected to be exiſting at this day: but this is not the caſe; there is indeed ſtill a Lighthouſe, but of a much more humble form, riſing out of the midſt of an irregular caſtle or garriſon, kept in this iſland, and which is now called *Farion*.——Upon what occaſion this famous building was deſtroyed or met its deſtruction, hiſtory is, as far as we know, totally ſilent: but the *Nubian* Geographer mentioned before, ſpeaks of it, not only as a building ſubſiſting in his time, but in perfect good condition: for, he ſays, there is nothing like it in the whole world, for the fineneſs of the edifice, or the ſtrength of its ſtructure; for, beſides that it is built of the hardeſt *Tiburtine* ſtones, theſe ſtones are alſo joined together with melted lead, and ſo firmly connected that they cannot be looſened from one another; for the ſea beats againſt the very ſtones wherewith it is built, upon the north ſide†.

ABULFEDA an *Arabic* writer who lived in the 14th century, amongſt the ſtupendous monuments of *Egypt*‡, deſcribes the *Pharos* as being 180 cubits high; that is 120 cubits leſs than it had been deſcribed by former authors; and particularly the *Nubian* Geographer, who ſeems the moſt particular, and beſt founded: ſo that whether ſome decay happening in the upper works (where indeed it was moſt likely to happen) had occaſioned its height to be reduced, as the leaſt expenſive mode of repair; or that ABULFEDA meaſured by ſome other cubit than the ancient one; or that he has ſpoke of the dimenſions at random, or by hearſay, is now uncertain: but ſtill, as the lower and moſt ſolid parts were remaining about 400 years ago, it is evident that ſome extraordinary fate muſt have happened to it ſince that time; which cannot be accounted for merely by the neglect of it, conſequent upon the ruin of that empire. To have pulled it down would have been a work of ſo much labour, that even a wanton deſire of deſtruction would have been foiled in the attempt: and it is ſcarce poſſible to ſee that the demolition thereof could anſwer any real purpoſe. Nor can we ſuppoſe that it has been undermined by the ſea's gaining upon the rocks it was built upon; as thoſe are ſaid to be of *granite*. It ſeems therefore the moſt likely that it has been deſtroyed by the ſhake of an earthquake, at the ſame time producing a ſubſidence: and to this, the obſervations of modern travellers give ſome ſort of countenance; as it is ſaid that the foundations or ruins of art, are ſtill ſeen amongſt the rocks of the iſland *Farion*, under the ſurface of the water. At any rate we have authentic teſtimony of this ſtupendous tower's having ſubſiſted for a period of 1600 years §.

* The computations of the value of thoſe 800 talents in Engliſh money, by different authors, differ no leſs than from 330,000 to 80,000 pounds ſterling.

† The height of 300 cubits mentioned by this author, he leaves in no doubt, as to their being the ancient cubit; becauſe, he alſo ſays, the height of this building is 100 *ſtatures* of man; ſo that taking the cubit, as before, at 21,888 inches, the ſtature of man will come out 5 feet 5 ½ inches; agreeable to the ſtature of the *Egyptians*, which is ſaid to be rather low than tall.

‡ ABULFEDA's deſcription of *Egypt* tranſlated from the Arabic into Latin by *Profeſſor* MICHAELIS.

§ ABULFEDA mentions, that there was formerly, viz. about the beginning of *Mahomedaniſm*, in this Lighthouſe, a *Speculum* formed of *Chineſe ſteel*, in which the ſhipping could be ſeen in the port of *Conſtantinople*; but of which it was deprived by the intriguing practices of the *Chriſtians*.——That ſuch a Speculum *might* be formed, and erected with ſuch *intent*, is not to be diſputed: but *Conſtantinople* being diſtant from *Alexandria* no leſs than 700 miles, as it was impoſſible for an obſerver at the former to ſee the Pharos, ſo it was as impoſſible for a perſon on the Pharos to ſee any thing at Conſtantinople; it being equally impoſſible that any thing could be ſeen by reflexion, which an obſerver at the Speculum could not ſee by a direct view: and therefore if ſuch a *Speculum* ever exiſted, its removal may be accounted for, without having recourſe to the *intriguing arts* of Chriſtians, or others; namely by its not *anſwering the end* for which it was made.

FROM

FROM this Lighthouſe, as the moſt celebrated, ſtructures of this kind have generally obtained the ſame name; as the *Faro di Meſſina* and others: but the moſt remarkable amongſt the moderns is the *Tour de Cordouan* ſituated near the coaſt of *France*, upon a ſmall iſland near the mouth of the river *Garonne* in the bottom of the bay of *Biſcay*.

THIS LIGHTHOUSE was begun above 200 years ago, in the reign of HENRY II. of *France*; was 26 years in building; was finiſhed in the reign of HENRY IV. in the year 1610; and was the work of LOUIS DE FOIX a celebrated *French* architect.

THE iſland upon which it is built is dry at low water, and wholly covered with the tide at high water. It is a bare rock, the upper ſurface of which, except its natural aſperities, is nearly level, and at low water is about 500 fathoms in length, from north to ſouth, and 250 fathoms in breadth from eaſt to weſt. It is ſurrounded with detached rocks, which giving a reſiſtance to the ſeas, they break upon them in blowing weather, with an horrible noiſe: and the acceſs to this tower is rendered very difficult by the great *ſurf* that generally breaks upon it; ſo that nothing larger than boats of three tons burthen can approach it with ſafety; and that only by one paſſage of ſixty fathoms wide, reaching within 100 fathoms of the tower, where there is a ſand, upon which the boats ground at low water.

ON the level rocky ſurface above deſcribed, and nearly in the middle of the iſland, the building is founded; and the baſe fills a circle of no leſs than 135 feet in diameter, *Engliſh* meaſure.——Upon the whole extent of this baſe, the work is carried up entirely ſolid with maſonry (except the opening of the ſtone ſtairs) to the height of eight feet, or thereabouts, which I ſuppoſe to be nearly on a level with the ſurface of the ſea at high water. A cavity is then left in the middle of the area, of above 20 feet ſquare, to form the cellar, and a freſh water ciſtern; this riſes eight feet more, including the arches that cover it. The remainder of the area is built up quite ſolid with maſonry (except the opening before mentioned) to the level of the top of the arches; the whole there making one regular floor or platform; but as the outſide ſurface is built ſloping, or *battering* (as it is termed) from the perpendicular, the diameter of the greateſt circle is there reduced to 125 feet.——The ſtone ſtair-caſe begun, and carried up in the ſolid, from about four feet high above the rock, to the platform already deſcribed, is on the eaſt ſide, being that next the ſhore. The aſcent from the rock to the beginning of the ſtone ſtairs, is on the outſide, by a wooden ladder, and the entry is ſhut by ſtrong wooden doors, on the outſide.

Within the circumference of this platform, at the diſtance of 12½ feet, is drawn a circle of 100 feet diameter; and the ſpace of 12½ feet between the inner and outward circles, limits the thickneſs of a circular wall; which is carried up ſomewhat battering on the outſide, and perpendicular within, to the height of 12 feet, being 11 feet thick at the top; which circular figure, renders this wall, which in itſelf is ſo ſtout, ſtill more able to reſiſt the action of the weſtern ſeas, in like manner as the parapet of a *Mole*.——There ſeems in the whole building no idea of defence againſt the attacks of an enemy; yet to defend the entry againſt ſmall thieves and plunderers, a lodgment, in fortification called a *Machicoulis*, is built upon the wall over the ſtairs.

IN the middle of this clear area of 100 feet diameter, the baſe of the tower is begun upon a circle, the diameter of which is 50 feet; and the building is carried up from thence, by diminiſhing ſtories, to the height of 115 feet; at which level is the baſe of the lantern, which originally was of ſtone, and domed over; the doming being ſupported upon eight ſtone pillars or *mullions*, with openings between them for the paſſage of the light; and it was finiſhed above, with ſmall ſpire-like ornaments.

THERE being according to this deſcription a ſpace of 25 feet between the inſide of the circular wall, and the outſide of the tower; this ſpace is in part occupied by ſeveral ſmall rooms, which were built within the parapet, and ſerved as lodgings for four light-keepers; and alſo for ſtore-houſes, for the reception of the different articles neceſſary for their own maintenance, as well as for the light itſelf: ſo

that

that the light-keepers having nothing to do in the ſeveral other apartments of the tower (the cellar excepted) but to go up a circular ſtair-caſe, carried up (partly in the thickneſs of the wall, and partly on the outſide) from the level of the platform, to the commencement of the lantern; the different apartments of the tower are by that means preſerved clean, and free from incumbrance.

THOSE different ſtories and apartments being highly finiſhed, and ornamented within and without, a further deſcription of a ſubject but little known in *England*, will I doubt not be agreeable to my reader.——There are four different ſtories that principally diſtinguiſh themſelves on the outſide, and are ornamented with columns, of different *orders*. Thoſe of the baſe ſtory are *Doric*, the next ſeem to be a ſpecies of the *Ionic*, the third are *Corinthian*, and the uppermoſt, which ornament the lantern, are of the *Compoſite* order.

THE principal room on the ground floor is a great Hall of 22 feet ſquare, by 20 feet high, to which are annexed two wardrobes, and other conveniencies; the whole arched over. Above this, on the firſt floor is the *king*'s apartment, comprehending a grand *Saloon* 21 feet ſquare, and 20 feet high; a *Veſtibule*, two wardrobes, and other conveniencies, which are arched over with flat elliptical arches. The next floor above, or ſecond chamber floor, is taken up by the *Chapel*, where maſs is performed, as often as the weather will permit the officiating prieſt to attend. This is a circular room covered with a dome, the internal diameter of which is 31 feet; its height from the floor to the top of the cornice of the *Corinthian* pilaſters, wherewith the inſide of the chapel is ornamented, is 22½ feet, and the dome being higher than hemiſpherical, makes the whole height near 40 feet. The inſide of the dome is a rich *Moſaic*, and receives light from eight *luthern* windows regularly diſpoſed. There is alſo a circular opening in the crown of the dome, of four feet diameter, not open to the ſky as that of the *Pantheon*; but being ſurrounded with a circular baluſtrade, and covered with the inferior lantern, it will have much the ſame appearance as the dome of *St. Paul*'s, when looking up from the floor on the inſide.

The diameter of this third ſtory, or inferior lantern, is 14 feet within. It is ſurrounded with a circular parapet, forming a *Balcony* round it; the internal diameter whereof is 21 feet, and it forms the *cap* of the ſolid ſtone cover of the dome of the chapel. This lantern is enriched on the outſide with eight Corinthian *Pilaſters*, applied to the eight ſupporting pillars, or mullions, between which are eight glazed windows, 2½ feet wide, and ſeven feet high. The inſide, which in this ſtory is leſs ornamented than it is without, is 20 feet up to the ſquare; and being covered with an hemiſpherical cupola, its whole height is 27 feet; and it is cloſed with a ſolid ſtone arch, which ſerves as a baſement to the lantern for the light.——The lantern juſt deſcribed ſeems deſtined to no particular uſe; ſerving only to give, by an agreeable figure, and a juſt gradation of diminution, the required *Elevation* of the principal *light*: it may however be conceived to be of occaſional uſe; for being glazed, a lamp or lamps, candles, &c. may be placed in any of its windows, at pleaſure, and give a full light in any direction, for any particular ſervice for which it may be wanted.

The original lantern for the *light* was of a diameter ſomewhat exceeding five feet clear, within, and nine feet without; and, as already ſaid, was externally ornamented with eight pillars of the *Compoſite* order. The unglazed openings between the ſupporting pillars, being but little bigger than the ſolid mullions, thoſe openings therefore could ſcarcely exceed twelve inches wide in the *clear*. The height of this lantern was 17 feet to the top of the cupola, which was of ſtone; and there, a perforation was left in the middle of it about 18 inches in diameter, by which the ſmoke of the fire might aſcend into another little turret of 2½ feet external diameter; and paſs out of its openings, which ſomewhat reſembled *pigeon-holes*. This little turret was capped over with a ſolid ſtone cupola, upon which a ſmall ſtone ſpire or pinnacle was erected, that terminated the whole at the height of 31 feet above the floor of the lantern of the light. The total height of the building therefore was 146 feet *Engliſh* meaſure, above the baſe of the tower; and 162 feet above the ſurface of the rock.

BESIDES the ornaments already deſcribed, the king's apartment was decorated with the arms of *France*, and alſo with the buſts of HENRY II. and HENRY IV. in niches: likewiſe with a figure in ſtone repreſenting MARS, with his proper attributes; and a female figure in ſtone, holding a palm in one hand, and a crown in the other. The buſt of the architect LOUIS DE FOIX was placed in the chapel: to which the buſts of LOUIS XIV. and of LOUIS XV. were added in the year 1735.

I have here deſcribed the ornamental parts as being of the *Greek* and *Roman* orders, to which indeed they the moſt nearly refer; but a number of ornamental parts and mouldings, derived from the *Gothic* architecture, are intermixed; ſuch as turrets, pinnacles, &c. the compoſition of the whole is however in a ſtyle really grand and ſtriking.

M. BELIDOR, from whoſe deſcription and draughts* I have extracted what relates to this tower, ſeems to blame the architect; and much to lament that ſo great a profuſion of ornaments ſhould have been beſtowed upon ſo inhoſpitable a place†. But here it ſeems to me, that M. BELIDOR ſomewhat miſtakes the matter. Had this building been erected at the coſt of private adventurers; their endeavours no doubt ought to have merited the approbation of their fellow citizens, though they had contented themſelves with merely doing what was *neceſſary*; provided they had not ſtopped ſhort of doing that in the *beſt way*: but as this work appears to have been undertaken and carried on by a Series of *Kings*, who probably had the *Pharos* of *Alexandria* in view; the *Tour de Cordouan* muſt have been intended by them, not only as a work of public utility, but as a work of *Magnificence*: for, according to Mr. POPE, "'tis only *uſe* "that ſanctifies expence."

TO the above account it is neceſſary to add, that the fire made in the lantern was of *oak wood*, depoſited in a kind of large *chafing-diſh*, elevated about ſix feet above the floor of the lantern; and that the bulk of the fire muſt neceſſarily exceed the bulk of the mullions; otherwiſe, when a mullion interpoſed to the eye of the ſpectator at a diſtance, he would perceive little, or rather, would not be able to perceive any light: this, in conſequence produced a larger bulk of fire than otherwiſe might have been neceſſary; ſo that after the period of a century from the finiſhing of the building, it was found, that the fire had *calcined* the inſide of the walls, and to prevent its falling‡, the *French* court ordered the lantern to be taken down in the year 1717, and the fire to be lighted *below*.——The change however had not long ſubſiſted before the whole marine complained of their not being able to ſee the light at ſea, at the diſtance of *two* leagues§, as they uſed to do: and in the year 1720 this occaſioned M. LE COMTE DE TOULOUSE, Admiral of France, and M. LE MARECHAL D'ASFELD, Director of the Fortifications, to give the ſuperintendence of this tower to M. BITRI, Engineer in Chief at *Bourdeaux*; who diligently applied himſelf to eſtabliſh the light at its ancient height, and to remove the inconveniencies of the former; one of the moſt material, being the bulkineſs of the *ſtone* mullions, which ſtopped a great part of the light that the fire gave.

HE therefore contrived, upon the platform which was the baſe of the former, to erect a lantern or cage of *iron*, conſiſting of four principal pillars, and ſupporting a cupola above, which was finiſhed with a large ball, and a *vane*, 36 feet above the platform; and was compleated in the year 1727, with all the ſucceſs that was expected; after the public had ſhifted with having the fire below for the term of ten years. ‖

* Architecture *Hydraulique*, Tom. iv. page 151.

† "Il eſt ſeulment fâcheux, qu'un auſſi bel édifice ſoit placé dans le lieu le plus ingrat du monde, qui ne méritoit point aſſurément la dépenſe qu'on y a faite; mais voilà comme en uſent aſſez ordinairement, ceux qui ne ſont qu' architects; qui mettent ſans diſtinction, des ornaments par-tout, ſans trop ſe ſoucier de remplir l'objet principal." BELIDOR, Tom. iv. p. 152.

‡ From this circumſtance it appears that this tower is built of a calcareous freeſtone, ſuch as *Portland*, *Bath Stone*, &c.

§ *Deux Lieues*. BELIDOR, Tom. iv. p. 153.

‖ It may here be remarked, that this entire change of *principle* in the re-conſtruction of the lantern, took place many years after the eſtabliſhment of a lighthouſe upon the *Eddyſtone*.

THERE

THERE is one thing described of this new lantern, that should not pass unnoticed; as it was I apprehend, the first attempt of the kind. The lantern being entirely open, the smoke could escape on all sides: instead therefore of composing a funnel in the upper works as before, or forming an hollow cupola internally; the area of the great circle of the cieling of the cupola, was made the base of an inverted cone, whose *Apex* projected downwards about three feet: the entire sloping surface of this cone was then covered with tin plates, which becoming so many reflecting surfaces, served to increase the light of the fire, and made it to be perceived at a greater distance *.

THE CONSTRUCTION of a Lighthouse upon the *Edystone Rock*, has from its very origin, been considered as one of the artificial wonders of this kingdom: and so great was the curiosity of the public, at the completion of the present building, in the year 1759; and such were the numbers, by the intercession and recommendation of friends, that for some years after, flocked daily to see the model; that, to avoid having the whole of my time consumed in satisfying their curiosity, I found myself under a necessity of deputing Mrs. SMEATON, to shew and explain the model. I was honoured also with the command of his *present* MAJESTY, to shew and explain the same to himself, and our GRACIOUS QUEEN: when his MAJESTY shewed such a degree of attention to, and criticism thereon, as I have scarcely met with from any of his subjects. It was also exhibited to the late PRINCESS DOWAGER OF WALES, and the DUKE OF CUMBERLAND, at their especial requests; and the late DUKE OF YORK was pleased to honour the works themselves with his inspection, while they were carrying on at *Plymouth*.

The seeming avidity that the public shewed to be made acquainted with the detail of the construction of this building, concurred with other considerations, that I will presently mention, in determining me, to listen to the wishes of my friends, in publishing an account thereof; together with such matters, as in point of utility or curiosity related thereto, and might be acceptable: but nothing more effectually weighed in my mind, than the earnest request of the gentlemen who employed me in the work itself; and more especially as this was strengthened by the same request, from several gentlemen of the *Trinity House*; that I might publish an account of my proceedings; together with as much as I had learnt concerning the former buildings; to the end, that if any future unforeseen accident should unhappily cause the destruction of the present edifice, posterity might not be at a loss for the discovery of the errors and imperfections both of the present and former buildings; so as to avoid or pursue the principles already followed, as the improved *genius* and skill of the age should judge to be most expedient.

It is indeed as natural for me to wish, there may never be any occasion to resort to this treatise for *that* End; as it would be presumptuous to say there never could. He only who first created the atoms, can ascertain what is the *full* extent of those powers, that may possibly be combined, towards the destruction of the mass; but with respect to myself, it would surely be more creditable that the building should be permanent, than that it should be said to be well contrived, and the means of its restoration well described: and further, though the situation of this building is so peculiar, that there may not in the whole world be an occasion of erecting a structure *perfectly similar*; yet I have myself always found, that exact accounts of buildings which were in any degree remarkable, and actually executed, were much more instructive to my mind, than *systematical* writings†: and when a new method of operation, or a new

* We are told by the same author, that in *fact* it had this effect; but it would have been more satisfactory if we had been told, how *long* it continued to have that effect: as a reflecting surface placed directly above the fire, and exposed to the smoke, must be expected in a little time to get such a tarnish, as could not easily be rubbed off: and it may be a further *query*, whether the superiority of the light, might not altogether proceed from the lessening of the interposing solids, and from their having a fire grate containing 225 lb. *French* weight, of *pit coals*, which are said to be laid on at once, and to last the whole night; in lieu of a much smaller fire of *oak wood*; (which though it gave a great flame for the time, yet is said scarcely to have lasted three hours) rather than from the reflection of the *tin plates*.

† Previous to my entering upon the building of the *Edystone Lighthouse*, I perused PRICE's account of *Salisbury Cathedral*, and the *Parentalia* of Sir CHRISTOPHER WREN, with particular satisfaction: and though another stone for the base for the statue of *Czar* PETER may not be wanted, amongst all the monarchs of *Europe*, yet the account given of that *great* operation by CARBURI, cannot but inspire every artist that reads it, with new ideas, accompanied by a wish that it had fallen to his own share to execute the same.

Idea

Idea is once ſent forth, it is impoſſible to ſay, to how many good purpoſes it may by ingenious men be applied.

IN conſequence of my determination to publiſh; ſome progreſs was made in the preſent work, between the time of compleating the building, and the year 1763; and his MAJESTY having ſignified his pleaſure to honour the deſign with his patronage, ſeveral drawings were prepared, and engraven, ſome of which were executed by the late celebrated Mr. EDWARD ROOKER: but by the time matters were brought into this train, I found myſelf ſo exceedingly preſſed with buſineſs in my profeſſion of a *civil Engineer*; and this being ſhortly after ſucceeded by an appointment, to be one of the receivers of the *Derwentwater Eſtate* for *Greenwich Hoſpital*†; that, together with the hurry naturally attending the commencement of ſuch an appointment, obliged me to ſuſpend at that time, the further proſecution of the ſubject; and the conſequent ſucceſſion of engagements, not only in this, but at the ſame time in ſome of the principal undertakings in this kingdom, in my line of profeſſion, which called me forth *almoſt* againſt my will‡, put a total ſtop to any further proceeding upon the deſcription of the *Edyſtone Lighthouſe*, till the year 1783; when a ſevere attack upon my health rendered it adviſeable, for the *preſervation of life*, to deſiſt from entering upon any *freſh* undertakings; by which means at the end of that year, I had ſo far got myſelf cleared of the preſſure of former engagements, and was ſo far recovered in point of health, as ſeriouſly to begin to think once more of re-commencing my deſign.

I ſhall now proceed to give an account of the *Edyſtone Rocks*, and circumſtances relative thereto, principally from my own obſervations on the ſpot, during the time of erecting the *preſent* Lighthouſe; and of *former Buildings thereon*, ſo far as at this time I am able to collect the particulars.

† This aroſe from the patronage of the Earl of EGMONT, then firſt Lord of the *Admiralty*, to whom I had not the honour of being perſonally known; and the good offices of my much honoured friend the preſent Lord HOWE, then one of the Lords, and now *firſt* Lord of the *Admiralty*.

‡ In the ſpring of the year 1767 the *Speaker's Warrant* was ſerved upon me to *oblige* me to attend the Houſe of Commons, upon the propoſition of the *Forth and Clyde Canal*, then propoſed to be made from ſea to ſea in the ſouth of *Scotland*.

BOOK I. CHAPTER I.

CONTAINING

A General Account of the EDYSTONE ROCKS.

1. THE ſubject I have before me, will I conceive be rendered more perſpicuous, by beginning with a general deſcription of the *Edyſtone Rocks*, as they exiſt in nature, independently of any building; as this will at once explain the ſource and reaſon of thoſe difficulties, that muſt neceſſarily ariſe in the conſtruction of an edifice upon them.

Name.

2. THE *Edyſtone Rocks* are ſuppoſed to have got this appellation from the great variety of contrary *Sets* of the tide or current amongſt and in the vicinity thereof; both upon the tide of *Flood*, and the tide of *Ebb*: and this uncertainty of the current, would be ſtill further increaſed, from the following circumſtances, to thoſe who might not formerly be fully acquainted with the general *Set* of the *Channel-Tide* in theſe parts.

3. THE turn of the tide to the eaſtward from the weſt, and the contrary; that is to ſay, *up* channel and *down*, not happening at the time of high and low water, as is commonly the caſe in tide rivers; but the change of direction or time of *Still Water*, being when the water has flowed to half its height from low water, and when it has fallen from high water to half its ebb, it is ſaid to change its direction at *Half Tide*; and the technical term for this diſpoſition of the tides is, that they are ſaid to run *Tide and Half Tide*: and it would be ſo in this diſtrict of the channel, whether there were any rocks here to interpoſe and diſturb the regular *Set* of the tide, or not: which compounded with the particular Sets, occaſioned by the interpoſition of this *Congeries* of irregular rocks, makes the currents in reality ſo irregular, that there is much need of a knowledge of the local ſituation, to ſhun the danger of coming near them; and therefore they may very properly be termed (as they are) the *Edyſtone* Rocks.

Situation.

4. THE Edyſtone Rocks are ſituated nearly S. S. W. from the middle of *Plymouth Sound*, according to the *true* meridian; which I always mean when not otherwiſe particularly expreſſed; that is, allowing two points of variation (as in the preſent times) of the north end of the magnetic needle to the weſtward; this will make their bearing by the compaſs, from the middle of the Sound, now, at or about S. W. and the diſtance, as nearly as I can collect it from obſervations, is 12¾ miles; and from the ſame point in the Sound to the Jetty Head called the *Barbican* in the port of Plymouth is 1¼ mile more, which makes the diſtance of the Edyſtone from the port of Plymouth to be nearly 14 miles. See Map of the Coaſts, N° 2.

The promontory called *Ram-Head* is the neareſt point of land to the Edyſtone, which bears from thence ſouth, ſcarcely one point weſt, diſtant about 10 miles; and conſequently by the compaſs is nearly S. W. b. S.——Thoſe rocks are nearly in a line, but ſomewhat within that line, which joins the *Start*, and the *Lizard* points: and as they lie nearly in the direction of veſſels coaſting down and up the channel, they muſt, before a lighthouſe was eſtabliſhed thereon, have been very dangerous, and often fatal to ſhips under ſuch circumſtances; and many rich ſhips and other veſſels, have in former times been

actually loſt upon thoſe rocks, particularly ſuch as were homeward bound from foreign Ports: it being even now, a common thing in foggy and thick hazy weather, for homeward-bound ſhips, from long foreign voyages, to make the *Edyſtone Lighthouſe*, as the firſt point of land of *Great Britain*; ſo that in the night, and nearly at high water, when the whole ranges of theſe rocks are covered, the moſt careful mariner might run his ſhip upon them, if nothing was placed there by way of warning.

5. I WILL by this time ſuppoſe my reader to have alſo laid before him the chart N° 1, of the *Seas ſurrounding* the Edyſtone lighthouſe; from which he will ſee, that a line drawn from the *Lizard* point, to the neareſt point of land upon the coaſt of *France* towards *Uſhant*, will form the openings of the headlands of the *Britiſh Channel*, into the *Bay of Biſcay* and the *Atlantic* Ocean; theſe headlands being diſtant from each other about 31 leagues. It is further obſervable, that the lighthouſe lies, not ſo much as one half of that opening, in a north-eaſt direction, within, or *up Channel* of the ſaid line; and that the *Bay of Biſcay* and *Atlantic* Ocean lie open to the *Edyſtone*, from the S. b. W. point to the W. b. S.; and in conſequence, that it lies open to the *ſwells* of the *Bay* and *Ocean*, from all the ſouth weſtern points of the compaſs; which ſwells are generally allowed by mariners to be very great and heavy in thoſe ſeas, and particularly in the *Bay of Biſcay*. It is to be obſerved, that the ſoundings of the ſea from the ſouth weſtward towards the Edyſtone, are from 80 fathoms to 40, and every where till you come near the Edyſtone, the ſea is full 30 fathoms in depth; ſo that all the heavy ſeas from the ſouth-weſt, come uncontrouled upon the *Edyſtone Rocks*, and break thereon with the utmoſt fury.

6. A CIRCUMSTANCE that greatly tends to augment the force and height of the ſeas ſo breaking upon thoſe rocks, is their particular form and poſition, as will in part be underſtood from the *general Plan* of the Edyſtone rocks N° 3, by which it will be ſeen, that they not only ſtretch acroſs the channel in a north and ſouth direction to the length of above 100 fathoms; but that they lie in a ſloping manner toward the ſouth-weſt quarter: and the ſloping (or *ſliving* of the rocks as it is technically called) does not ceaſe at low water, but ſtill goes on progreſſively, ſo that at 50 fathoms weſtward, there is 12 fathoms water; nor do they terminate altogether, at the diſtance of a mile; but at two miles diſtance there is doubtleſs *clean Ground*, being a white ſand, as common to this part of the channel.——From this configuration it happens, that the ſeas coming uncontrouled from the deep water, and rather ſuddenly at *laſt*, though gradually meeting the ſlope of the rocky bottom, they are ſwelled to that degree in ſtorms and hard gales of wind, as to break upon the rocks, with the moſt dreadful violence; as may in ſome degree (and in ſome degree only) be comprehended from the *Tablet* in the *Title page*. Nor is the effect of this ſlope leſs ſenſible, in proportion, in moderate weather; and it is frequently very troubleſome even in calm weather; for the libration of the water, cauſed in the *Bay* of *Biſcay*, in hard gales at S. W. continues in thoſe deep waters for many days, though ſucceeded by a calm; inſomuch, that when the ſea is to all appearance ſmooth, and even, and its ſurface unruffled by the ſlighteſt breeze, yet thoſe librations ſtill continuing, which are called the *Ground Swell*, and meeting the ſlope of theſe rocks, the ſea breaks upon them in a frightful manner, ſo as not only to obſtruct any work being done upon the rock, but even the landing upon it, when, figuratively ſpeaking, you might go to ſea in a *Walnut-ſhell*.

7. A STILL further circumſtance, that even yet increaſes the difficulty of working upon the rock in moderate weather, will be apprehended from conſidering the particular plan and elevation N° 7 of what is now called the *Houſe Rock*; every building having been made upon it, as the largeſt and higheſt; where, in the plan, upon the line A B, there is a ſudden drop of the ſurface of the rocks, forming a ſtep, of about 4 or 5 feet high; this face or front exhibited in the upright view, alſo by the letters A B, ſomewhat overhangs the perpendicular towards the weſt; ſo that the ſeas which in moderate weather come ſwelling towards this ſtep, meet ſo ſudden a *check* thereby, that they frequently fly to the height of 30 and 40 feet, even when people are working upon the rock; and the broken water coming down upon the area of the lighthouſe, the workmen muſt of neceſſity be thoroughly wetted, and often do their buſineſs in a very uncomfortable ſituation. I would not however be underſtood that this is the caſe, at *all times* in moderate weather; but only when the ground ſwells come home from the Bay; for when the wind is in

any

any of the eaſterly or northerly points, that is, quite round from the ſouth, by the E. and N. to the weſt point, if moderate it produces no ſuch effect; but yet, after a ground ſwell has been raiſed by a hard gale of wind at S. W. a wind blowing only moderately from the favourable points, will not quell it in leſs than 4 or 5 days time; and it is to be noted, that the ſouth-weſterly are the moſt prevalent winds of this part of the country, in the ſummer months, (when alone any thing can here be attempted with ſucceſs) and that when the wind blows *very freſh* at any point, all work here muſt ceaſe*.

8. FROM what has already been obſerved, it will appear, that the turn of the current of the tide from the weſtward towards the eaſt is at half flood; and that it remains in the ſame direction from that time forwards to high water, and afterwards till the half ebb: hence as the current of the tide, will in conſequence during the whole of the time from half flood to half ebb, *aid* the ground ſwell from the weſt; and the water at this time is alſo high upon the rocks, it will very rarely admit of any buſineſs being done upon the rock, in the moſt moderate weather, during this interval; which of courſe at once cuts off half the time, in the period of every tide.

9. THE particular declivity of the rocks in a ſtate of nature, will be readily judged of, by having recourſe to Plate N° 6 that contains the elevation of the laſt Lighthouſe; which is ſhewn by a ſouth view at the low water of a ſpring tide. The high water of the ſame tide, ſuppoſed unagitated, would not riſe to the top of the *Peak* of the rock, as it ſtood at the time of my taking the elevation, by three feet perpendicular; but the ſeas are ſcarcely ever ſo quiet here, as not to break entirely over it at high water. The ſudden drop, ſtep, or break of the houſe rock to the weſt, will be beſt explained by examining the Plate N° 9, containing the ſection of the preſent building; which ſection being upon the eaſt and weſt points, diſtinctly ſhews this drop, or overhanging ſtep, that creates ſo much trouble; there being, here, no other part of the rock before it, to hide it from the eye.

10. IT has been noticed, that the rocky ground at the bottom, extends conſiderably to the weſtward of the viſible rocks; it does ſo alſo to the eaſt, and to the north; in general, 14 to 20 fathoms deep at low water, at the diſtance of from a quarter, to half a mile; and, as I apprehend, ſtill deeper to the ſouthward; but of this laſt I have no minutes, having had no occaſion to be particular there.——This rocky bottom is alſo another natural impediment to the working upon the rock; for every undertaker muſt alike experience the neceſſity of having a veſſel of a competent ſize, to receive and lodge himſelf, his workmen and materials; and to have it *moored* in ſuch a ſituation as to be ſufficiently near, to effect a landing on the rock with ſmall boats, whenever it ſhall appear practicable ſo to do; and carry to, and return from the ſame what materials he has occaſion for. No man would however think of mooring his veſſel to the ſouth of the rocks; becauſe, if it broke looſe with a hard gale at ſouth, he would be intercepted by the rocks in his paſſage home; or if moored to the weſt or eaſt, if broke looſe by hard gales from thoſe quarters reſpectively, he would inevitably be driven upon the rocks, and the more perilous would be his ſituation, by being in the *drift* of the channel's tide; but on all the northern points, the land being within ſight, no very heavy ſeas can ever come from this quarter; and therefore, if here he was to break looſe from moorings, he will have every advantage in getting into port: but in this ſituation, though eligible for mooring, for the reaſons abovementioned, the rocks are ſo very ſharp, that a veſſel lying at anchor in moderate weather, is in danger of having her *cable* or *hawſer* chafed aſunder, and of loſing her anchor. Nothing therefore is to be done here *properly* without *chains*; and the weight thereof, that is neceſſary to prevent their being broke, or cut by the violent blows to which they will unavoidably be ſubject from thoſe ſharp rocks, is ſuch as muſt render them unwieldy and troubleſome in the management; eſpecially to a veſſel that for other reaſons, cannot be encumbered with hands; and in reality,

* This perhaps cannot be better illuſtrated than by obſerving; that to ſet the workmen *forward*, at different periods of the work, when there was to be a *change* in the mode of conſtruction; I have been obliged to continue on board our ſtore veſſel at an anchor, frequently a week, ſometimes 10, 12, 14, and once 18 days together, even in the months of *July* and *Auguſt*; when though the ſwell was quite gentle every where elſe; yet was it ſo furious upon the rocks, as to prevent our landing, though the common artificers were to be paid 6*d*. an *hour* for their work there.

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I found more difficulty and hindrance from this circumſtance of a rocky bottom, than I could poſſibly have imagined.

The component Matter or Subſtance.

11. THE *congeries* of rocks called the *Edyſtone*, appear to me to be all of the ſame kind of ſtone, and of a kind ſo peculiar, that I have not ſeen any ſtone exactly like it in *Cornwall* or *Devonſhire*, or indeed in any part of the kingdom; but the moſt ſimilar to it that I have ſeen, was in *Scotland*, yet that varied in ſome degree from it. It is of the kind that in *Cornwall* they call a *Killas* or hard ſlate*; but the ſubſtance thereof appears to be the ſame nearly, as the *Moor-ſtone* or *Granite* of that county; and it is in every reſpect quite as hard. It differs from the Moor-ſtone in this; inſtead of being compoſed of grains or ſmall fragments, united by a ſtrong cement, interſperſed with a ſhining *talky* ſubſtance, as the *Corniſh* Moor-ſtone in general appears to be; it is compoſed of the like matter formed into *Laminæ* commonly from one-twentieth to one-ſixth part of an inch in thickneſs; the ſhining talky particles lying between the *Laminæ*†. It coheres as ſtrongly together as Moor-ſtone, if ſplit according to the direction of the grain; but if attempted to be ſplit acroſs the grain, it is abundantly harder, and therefore, when worked by tools, it can by no means be brought to an *Arriſs* or ſharp corner; becauſe the texture is ſo much ſtronger one way than the other, that the force which is neceſſary to make an impreſſion in the harder direction, is ſufficient to crumble off the *Laminæ* from each other in that where they are leſs united. This ſtone is alſo in a conſiderable degree *elaſtic*, as will be ſhewn in the ſequel, eſpecially in endeavouring to divide it *with* the grain, which lies according to the *ſtiving* of the rocks; and is nearly one foot *dip* to the weſtward, in two feet horizontal, that is, in an angle of about 26 degrees with the *horizon*. The kind of work which can the moſt eaſily be done upon this rock is in *boring* or *drilling* holes into it, croſsways of the grain, as will be obſerved in its proper place; every thing elſe goes on with much labour, and difficulty, except that of ſplitting it in the direction of the grain.

General Directions.

12. THE time of the tides here, that is of high and low water, is nearly the ſame as at *Plymouth*, viz. V‡ at full and change of the moon. The common *Spring* tides flow from 16 to 18 feet, and the equinoctial tides from 18 to 20 feet; *neap* tides flow from 11 to 12 feet, and ſometimes to 14 feet.

The proper time of ſailing from Plymouth for the Edyſtone is at high water at *Plymouth*: becauſe the *Ebb Tide* from Plymouth Sound, will aſſiſt in getting out of the Sound, and then meeting the *Channel*'s tide running eaſtward, the current will naturally ſet you ſo much eaſt, that if your wind is ſlack, the return of the current to the weſt, at half ebb at the Edyſtone, will bring you back thither, in courſe, before low water, and give you the beſt chance of landing. The moſt favourable wind, both for going out, landing, lying there and returning, is at N. W.; for that wind not only anſwers for the paſſage both ways; but being a *Land-wind*, it muſt blow hard before it raiſes any conſiderable ſea at the rock; and the landing-place being on the eaſt ſide of the houſe rock, that *reef*, ſtretching north and ſouth, becomes a *Pier* or *Mole* for breaking off the ſea, from half ebb to low water, and from thence till half flood; which interval of time, when the weather permits, is the beſt for landing and ſtaying there. The moſt unfavourable wind for every purpoſe is the S. W. as will eaſily be conceived from what has been already deſcribed.

* Pryce's Mineral. Cornub. explanation of terms, p. 323.

† This is the account of it that I received from my ingenious friend the late Mr. William Cookworthy of *Plymouth*, *Chemiſt*, who had been very curious in his reſearches upon the foſſils, and particularly the *Moor-ſtone* of *Cornwall*; having found that to be a ſubſtance, which being acted upon by an intenſe fire, becomes the proper baſis of *China-ware*; and a ſpecies of Moor-ſtone having been found by him not diſcoloured by the *talky* matter, a manufactory upon this principle has ſince been carried on at *Briſtol*.

‡ Having tried the ſpecific gravity of *Moor-ſtone* and that of *Edyſtone*, I find the difference inconſiderable: Moor-ſtone being 2,625; Edyſtone 2,639 times that of water.

CHAP. II.

Concerning the Conſtruction of the Lighthouſe upon the Edyſtone built by Mr. WINSTANLEY.

13. THE many fatal accidents that were frequently happening to ſhips by running upon the Edyſtone rocks, and particularly to thoſe that were homeward-bound, we muſt ſuppoſe to have made it a thing very deſirable to have a Lighthouſe built thereon, and that for many years before any competent undertaker appeared: for, from the circumſtances which have been fully ſtated in the preceding account of the natural ſtate of theſe rocks; it would appear to thoſe then beſt acquainted with them, that the difficulties neceſſarily attending ſuch an undertaking, were likely to prove inſuperable: and perhaps in reality it may have been a peculiar advantage to every undertaker, and to the undertaking itſelf, that no one could, previous to the actual commencement of the work, be fully ſenſible of the difficulties which would inevitably attend it; and which he muſt ſurmount or fail of ſucceſs.

14. HOWEVER, formidable as it was, we learn that in the year 1696, Mr. HENRY WINSTANLEY of *Littlebury* in the county of *Eſſex*, Gent. was not only hardy enough to undertake it, but was furniſhed with the neceſſary powers to put it in execution. This it is ſuppoſed was done in virtue of the general powers lodged in the *Maſter*, *Wardens* and *Aſſiſtants* of TRINITY HOUSE at *Deptford Strond*, to erect ſea marks, &c. by a ſtatute of QUEEN ELIZABETH, whereby they are impowered "to erect and ſet up beacons, marks and ſigns for the ſea, needful for avoiding the dangers; and to renew, continue and maintain the ſame."——But whether Mr. WINSTANLEY was a proprietor or ſharer of the undertaking under the TRINITY HOUSE, or only the directing engineer, employed in the execution, does not now appear.

15. THIS gentleman had diſtinguiſhed himſelf in a certain branch of mechanics, the tendency of which is to raiſe wonder and ſurprize. He had at his houſe at *Littlebury* a ſet of contrivances ſuch as the following:——Being taken into one particular room of his houſe, and there obſerving an old ſlipper careleſsly lying on the middle of the floor; if, as was natural, you gave it a kick with your foot, up ſtarted a *Ghoſt* before you: if you ſat down in a certain chair, a couple of arms would immediately claſp you in, ſo as to render it impoſſible to diſentangle yourſelf till your attendant ſet you at liberty: and if you ſat down in a certain arbour by the ſide of a canal, you was forthwith ſent out *afloat* to the middle of the canal, from whence it was impoſſible for you to eſcape, till the manager returned you to your former place.——Whether thoſe things were ſhewn to ſtrangers at his houſe for money, or were done by way of amuſement, to thoſe that came to viſit the place, is uncertain, as Mr. WINSTANLEY is ſaid to have been a man of ſome property: but it is at leaſt certain, that he eſtabliſhed a place of public exhibition at *Hyde Park Corner*, called WINSTANLEY's *Waterworks*, which were ſhewn at ſtated times, at one ſhilling each perſon: the particulars of thoſe waterworks are not now known; but, according to the taſte of the times, we muſt naturally ſuppoſe a great variety of *jets d'eau*, &c.*

Thoſe particulars relative to Mr. WINSTANLEY are indeed of little importance at preſent, either to the public or to the deſign of this publication, otherwiſe than as they may ſerve to give a ſketch of the talents and turn of mind of this original undertaker; and to account for the whimſical kind of buildings that he erected upon the Edyſtone, for the purpoſe of a Lighthouſe; as it would ſeem, from the deſign

* It appears that the exhibition of theſe waterworks continued ſome years after the death of Mr. WINSTANLEY, as they were exiſting in the month of September 1709, being mentioned in the *Tatler* of that date.

thereof, that it was not ſufficient for his enterprizing genius, to erect a building upon a ſpot, where of all others it was the leaſt likely to ſtand unhurt; but that he would alſo give it an elevation, that in appearance ſhould be the moſt liable to ſubject it to damage from the violence of wind and ſeas.

16. THE following comprehends an account of two different buildings that he erected there, and is chiefly extracted from what was written upon the large copper plate print addreſſed to Prince GEORGE of *Denmark*, then Lord *High Admiral* of *England*, containing a perſpective elevation of his finiſhed Lighthouſe; which, drawn orthographically and reduced to the ſame ſcale as the ſubſequent buildings are adjuſted to, is ſhewn in Plate N° 5 of the preſent work. The account I refer to, is intituled by Mr. WINSTANLEY,

" *A Narrative of the Building.*

17. " THIS Lighthouſe was begun to be built in the year 1696, and was more than four years in building: not for the greatneſs of the work, but for the difficultie and danger in getting backwards and forwards to the place; nothing being or could be left ſafe there for the firſt two years, but what was moſt thoroughly affixed to the rock, or the work at a very extraordinary charge: and though nothing could be attempted to be done but in the ſummer ſeaſon, yet the weather then at times would prove ſo bad, that for ten or fourteen days together, the ſea would be ſo raging about theſe rocks, cauſed by outwinds, and the running of the ground-ſeas coming from the main ocean; that although the weather ſhould ſeem, and be moſt calm in other places, yet here it would mount, and fly more than 200 feet, as has been ſo found, ſince there was lodgment upon the place: and therefore all our works were conſtantly buried at thoſe times, and expoſed to the mercy of the ſeas*; and no power was able to come near, to make good or help any thing, as I have often experienced with my workmen in a boat in great danger; only having the ſatisfaction to ſee my work imperfectly at times, as the ſeas fell from it, and at a mile or two diſtance; and this at the prime of the year, and no wind or appearance of bad weather: yet truſting in *God*'s aſſiſtance for a bleſſing on this undertaking; being for a general good, and receiving moſt inexpreſſible deliverances, I proceeded as follows.

18. " THE *firſt* ſummer was ſpent in making 12 holes in the rock, and faſtening 12 great irons† to hold the work that was to be done afterwards; the rock being ſo hard, and the time ſo ſhort to ſtay by reaſon of the tide or weather, and the diſtance from the ſhore, and the many journeys loſt that there could be no landing at all; and many times glad to land at our return at places, that, if the weather permitted, would take up the next day to get to Plymouth again‡.

19. " THE *next* ſummer was ſpent in making a ſolid body, or round pillar twelve feet high, and fourteen feet diameter; and then we had more time to work at the place; and a little better landing, having ſome ſmall ſhelter from the work, and ſomething to hold by; but we had great trouble to carry off and land ſo many materials, and be forced to ſecure all things as aforeſaid every night§ and time we left work, or return them again into the boats.

20. " THE *third* year the aforeſaid pillar or work was made good at the foundation from the rock to 16 feet diameter, and all the work was raiſed, which to the vane was eighty feet. Being all finiſhed, with the lantern, and all the rooms that were in it, we ventured to lodge there ſoon after Midſummer, for the greater diſpatch of this work. But the firſt night the weather came bad, and ſo

* See the tablet in the title page.

† One of the irons about 3¼ inches diameter octagon, was cut out in the operations of 1756.

‡ From this deſcription it appears that they had not any ſtore veſſel to lie at moorings by way of conſtant retreat; but performed the work by ſingle journeys.

§ Hence it appears they did not work in the night.

continued,

continued, that it was eleven days before any boats could come near us again; and not being acquainted with *the height of the ſeas riſing*, we were almoſt all the time drowned with wet, and our proviſions in as bad a condition, though we worked night and day, as much as poſſible to make ſhelter for ourſelves. In this ſtorm we loſt ſome of our materials, although we did what we could to ſave them; but the boat then returning, we all left the houſe to be refreſhed on ſhore; and as ſoon as the weather did permit, we returned again and finiſhed all, and put up the light on the 14th of November 1698; which being ſo late in the year, it was three days before Chriſtmas before we had relief to get on ſhore again, and were almoſt at the laſt extremity for want of proviſions; but by good Providence, then two boats came with proviſions, and the family that was to take care of the light, and ſo ended this year's work*.

21. "THE *fourth* year, finding in the winter the effects the ſea had upon the houſe, and *burying* the lantern at times, although more than ſixty feet high; early in the ſpring, I encompaſſed the aforeſaid building with a new work of four feet thickneſs from the foundation, making all ſolid near twenty feet high; and taking down the upper part of the firſt building, and enlarging every part in its proportion, I raiſed it 40 feet higher than it was at firſt, and made it as it now appears; and yet the ſea, in time of ſtorms, flies in appearance, *one hundred feet above the vane*; and at times doth cover half the ſide of the houſe and the lantern, as if it were under water†."

22. BESIDES the above narrative, this print of Mr. WINSTANLEY's contains the following information.

"This Lighthouſe bears from *Plymouth* (or the entrance of the *Sound*) S. by W. and from the *Ram Head*, S. half a point caſtwardly; and is diſtant from the anchoring in the foreſaid Sound 4 leagues, and from Ram Head about 3 leagues and an half; which is the neareſt ſhore from the ſaid houſe: and the Iſle of *Mayſtone* bears from the Lighthouſe about N. E. by N. and is alſo four leagues diſtant; ſo that the ſhips coming from the Eaſt or Weſt, have much the ſame advantage of the light, that are bound for Plymouth. All the rocks near this houſe are on the caſtward ſide, but ſtretching north, and moſt ſouthwardly: all are covered at high water; but on the weſt ſide, any ſhip may ſail cloſe by the houſe, there being 12 or 13 fathoms water, and no hidden rock; but towards the E. by N. about a

* Though Mr. WINSTANLEY has not himſelf left any particular repreſentation of the building, deſcribed as the produce of theſe three years work; yet I am enabled to preſent the curious reader with the elevation thereof in plate N° 4. This is drawn orthographically to the ſame ſcale as the reſt; from a perſpective print ſaid to be drawn at the rock by JAAZIELL JOHNSTON, *painter*. I never ſaw but the ſingle copy in my poſſeſſion, and therefore at this time I muſt ſuppoſe it extremely ſcarce.

From the appearance of the baſement, it would ſeem to be of ſtone; and though Mr. WINSTANLEY does not ſay in his deſcription of the 2d year's work, which was that of making a *ſolid body*, or kind of round pillar, that it actually was of *ſtone*; yet from the manner of the expreſſion one would infer that to be the caſe; and which will appear more probable if we may ſuppoſe Mr. WINSTANLEY and his workmen ignorant at that time, of the proper manner of compoſing a cement capable of becoming hard under the utmoſt violence of the ſea; and in want thereof, he would doubtleſs after a winter's expoſure, find the joints of his ſolid pillar to be much waſhed, and the work itſelf looking ragged: it was therefore a natural expedient to ſurround the former pillar as deſcribed in the 3d year's work, with a caſe of ſtone of a foot thick; and not only to make the joints with all imaginable care, but to ſurround every joint with a *hoop* or *girdle* of iron or copper plate, of ſome inches in breadth, to hold in and ſecure the mortar from the waſh of the ſea; which mode of ſecurity is inferred from the repreſentation.

The height of the ſtone pillar here repreſented is 12 feet above the rock upon the upper ſide, and 17 feet on the lower ſide; it muſt therefore be ſuppoſed, in ſpeaking of 12 feet high, Mr. WINSTANLEY means above the rock on the higher ſide; or, as the print from whence this is taken, appears to be made from an *Eye Draught*, it may be an inaccuracy in the draughtſman.

The elevation appears to be taken from the ſouth at half tide, or when the ſea is overflowing the landing-place; which of courſe occaſions the rock to make a ſmaller appearance in this draught, than in any of the reſt.

A is the eye-bolt and ring upon the landing-place. B the ſloping ſurface of the rock. C the ſtone baſement. D the ſtore room. E the ſtate room. F the open gallery. G the kitchen. And H the lantern for the lights.

† See the tablet in the title page; which yet is ſhort of the height deſcribed by Mr. WINSTANLEY by 50 feet.

quarter

quarter of a mile diſtant from the houſe, lies an hidden rock that never appears, but at low ſpring tides, and therefore, not ſo well known, is the more dangerous.

23. " THE ſea ebbs and flows at this rock on ſpring tides 19 feet, and at high water all the rocks are covered, though a ſmooth ſea; and it is high water at the ſame time as at Plymouth; but it runs *tide and half tide*, ſo that it runs Eaſt 3 hours after it is high water, and yet the ſea falls lower; and it runs Weſt 3 hours after it is low water, and yet the ſea riſeth. At low tides, eſpecially ſpring tides, three great ranges of rocks appear very high, and lie almoſt parallel, ſtretching towards the S. E. and N. W. the houſe ſtanding the moſt Weſt of all. The forementioned hidden rock is a full cable's length from all theſe rocks, and lies as aforeſaid*."

24. THE plate N° 5 I have already had occaſion to remark is drawn orthographically from Mr. WINSTANLEY's perſpective elevation, from whence the above narrative is taken, and wherein

A repreſents the rock at low water.——B the landing place, covered at half tide, and all the time the current runs Eaſt.——C the entry door.——DE the baſement, which in the fourth year he deſcribes to have been added to the original one of 16 feet, ſo as to make an addition of four feet in thickneſs on every ſide; from hence it ſeems, that on the weſt ſide at D, it has been a work of ſtone; the joints appearing to have been covered with hoop plates, as before deſcribed of the original baſe; whereas the eaſt ſide E has the ſame appearance of having been wood; and to have been bound together with iron ſtraps, as the whole of the ſuperſtructure evidently was.——F is the ſtore-room with a projecting cabin to the ſouth-eaſt.——G the ſtate-room.——H the kitchen.——I the open gallery or platform.——K the lodging-room.——L the attending, or look-out room.——M the lantern for the lights, ſurrounded by a gallery or balcony.

N. B. The baſe is ſuppoſed completely to contain the original ſtone baſe of 16 feet diameter, which with the addition of four feet all round, makes the baſe of this ſecond ſtructure to be 24 feet diameter; and it appears to be partly round, and in part a *polygon*: but the works above the baſe are evidently upon a *dodecagonal* plan, or polygon of 12 ſides, till they riſe to the baſe of the look-out room, where, with all above, the building aſſumes an *octagonal* figure.

25. IT is very unneceſſary for me to enter into a further criticiſm upon either of thoſe ſtructures, as, with the information that I have collected, my reader will abundantly do that for himſelf; it is ſufficient to ſay, that it was no ſmall degree of heroic merit in Mr. WINSTANLEY to undertake a piece of work, that before had been deemed *impracticable*; and by the ſucceſs which attended his endeavours to ſhew mankind, that the erection of a building upon the *Edyſtone* was not in itſelf a thing of *that* kind: and it will be a further confirmation of the exceeding violence of the ſeas upon thoſe rocks; and of the augmented ſhock by the interpoſition of a building, when I mention, that on my firſt going to Plymouth in the year 1756, I was informed by an old gentleman who remembered both Mr. WINSTANLEY and his lighthouſe, that after it was finiſhed, it was commonly ſaid, that in time of hard weather, ſuch was the height of the ſeas, that it was very poſſible for a *ſix-oared* boat to be lifted up upon a wave, and driven through the open gallery of the lighthouſe.

26. EXCEPT the above, I have met with no occurrences concerning this building till the month of November 1703, when the fabric needing ſome repairs, Mr. WINSTANLEY went down to Plymouth to ſuperintend the performance thereof: and we muſt not wonder, if from the preceding accounts of

* For a more perfect account of the general ſhape and ſituation of the Edyſtone rocks, ſee the general plan thereof Plate N° 3; relative to which it is to be noted, that at the beginning of this century, the variation of the compaſs by Mr. FLAMSTEED was N. 7° ½ weſterly; whereas it is now become nearly 2 points of the compaſs to the W. of N.; which, with the common inaccuracy of reputed bearings, ſufficiently accounts for the difference of thoſe given by Mr. WINSTANLEY, from theſe ſet down in this plan.

the

the violence of the ſeas, and the ſtructure of the Lighthouſe, the common ſenſe of the public led them to ſuppoſe, this building would not be of long duration; and the following is an anecdote which I received, to the ſame effect from ſo many perſons, that I can have no doubt of the truth of it.

Mr. WINSTANLEY being amongſt his friends previous to going off with his workmen, on account of thoſe reparations; the danger being intimated to him, and that one day or other the Lighthouſe would certainly be overſet; he replied, "He was ſo very well aſſured of the ſtrength of his building, "he ſhould only wiſh to be there in the greateſt ſtorm that ever blew under the face of the heavens, "that he might ſee what effect it would have upon the ſtructure."

It happened that Mr. WINSTANLEY was but too amply gratified in this wiſh; for while he was there with his workmen and light keepers, that dreadful ſtorm began, which raged the moſt violently upon the 26th November 1703 in the night; and of all the accounts of the kind, which hiſtory furniſhes us with, we have none that has exceeded this in *Great Britain*, or was more injurious or extenſive in its devaſtation.

The next morning, November 27th, when the violence of the ſtorm was ſo much abated, that it could be ſeen whether the Lighthouſe had ſuffered by it, nothing appeared ſtanding, but, upon a nearer inſpection, ſome of the large irons, whereby the work was fixed upon the rock; nor were any of the people, or any of the materials of the building, ever found afterwards; ſave only part of an iron chain, which had got ſo faſt jambed into a chink of the rock, that it could never afterwards be diſengaged, till it was cut out in the year 1756.

27. THE above accounts are what I have received from old people at Plymouth; the following anecdotes are extracted from a book, publiſhed ſoon after the melancholy accident to Mr. WINSTANLEY and thoſe with him, entituled The STORM, printed *London* 1704.

"The loſs of the Lighthouſe called the *Edyſtone* at *Plymouth*, is another article, of which we never heard any particulars, other than this; that at night it was ſtanding, and in the morning all the *upper part of the gallery* was blown down, and all the people in it periſhed; and by a particular misfortune, Mr. WINSTANLEY the contriver of it; a perſon whoſe loſs is very much regretted by ſuch as knew him, as a very uſeful man to his country. The loſs of that Lighthouſe is alſo a conſiderable damage; as 'tis very doubtful whether it will ever be attempted again; and as it was a great ſecuritie to the ſailors; many a good *ſhip having been loſt there in former times.*

"It was very remarkable, that, as we are informed, at the ſame time the Lighthouſe aboveſaid was blown down, the model of it in Mr. WINSTANLEY's houſe at *Littlebury* in *Eſſex*, above 200 miles from the Lighthouſe, fell down and was broke to pieces*." Page 223.

"At *Plymouth* they felt a full proportion of the ſtorm in its utmoſt fury; the Edyſtone has been mentioned already; but it was a double loſs; in that the Lighthouſe had not been long down, when the *Winchelſea*, an homeward-bound *Virginia* man, was ſplit upon the rock where that building ſtood, and moſt of her men drowned." P. 212.

* This however may not appear extraordinary, if we conſider that the ſame general wind that blew down the Lighthouſe near *Plymouth*, might blow down the model at *Littlebury*.

CHAP. III.

Account of the second *Lighthouſe built upon the Edyſtone by* Mr. RUDYERD.

28. THE great utility that the Lighthouſe of Mr. WINSTANLEY had proved itſelf to be of, during its continuance, would of courſe prompt mankind to wiſh for another in its place; and the loſs of the *Winchelſea* Virginia man juſt mentioned, with others that may naturally be ſuppoſed to have ſhared the ſame fate, would doubtleſs prove powerful incentives to awaken the attention of thoſe moſt nearly concerned, to attempt a work, that with whatever difficulties it might in reality be attended, yet Mr. WINSTANLEY's building had demonſtrated to be a thing, not in its own nature *impoſſible* or *impracticable*.

It was not however begun afreſh quite ſo ſoon as it might naturally have been expected; for Mr. WINSTANLEY's Lighthouſe having been deſtroyed the 26th November 1703, it was not till the ſpring of the year 1706, that an act of parliament of the 4th of QUEEN ANN was paſſed for the better enabling the *Maſter*, *Wardens* and *Aſſiſtants* of TRINITY HOUSE at *Deptford Strond*, to rebuild the ſame; ſo that in the ſteps neceſſary for this, we muſt ſuppoſe ſome obſtruction; but the work itſelf was begun in the July following*.

29. BY this act of parliament, the duties payable by ſhipping, paſſing the Lighthouſe, were veſted in the corporation of TRINITY HOUSE at *Deptford Strond*, and it included powers to them to grant a leaſe thereof to an undertaker or undertakers, ſuch as they ſhould approve. In conſequence of theſe powers they agreed with a *Captain* LOVEL or LOVET for a term of 99 years, commencing from the day that a light ſhould be exhibited, and continuing ſo long as that exhibition ſhould laſt during the ſaid term.

* Extract from the preamble to this act 4th of ANN, chap. 20th.

" And whereas there now is, and time out of mind has been, *a very dangerous rock* called the *Edyſtone* lying off of *Plymouth* in the county of *Devon*, upon which divers ſhips and veſſels have been caſt away and deſtroyed: and whereas upon application ſome time ſince made to the ſaid *Maſters*, *Wardens* and *Aſſiſtants* by great numbers of maſters and owners of ſhipping to have a *Lighthouſe* erected upon the ſaid rock, offering and agreeing in conſideration of the great *charge*, *difficulty* and *hazard* of ſuch an undertaking, to pay the ſaid Maſter, &c. one penny per ton outwards, and the like inwards, for all ſhips and veſſels which ſhould paſs ſuch Lighthouſe (coaſters excepted, which ſhould pay twelvepence only for each voyage) they the ſaid Maſter, &c. having a due regard to the ſafety and preſervation of the ſhipping and navigation of this kingdom, did in the year 1696 cauſe a Lighthouſe to be begun to be erected on the ſaid rock: and in three years time a light was placed therein; and the ſaid Lighthouſe in the term of five years was, with much hazard and difficulty, and at a very great expence, fully built and completed to the great ſatisfaction of the flag officers and commanders of the fleet and ſhips of war, and of all others concerned in trade and navigation: the ſame being not only uſeful for *avoiding the dangerous rock upon which it was built*, but alſo a *guide and direction to ſhips paſſing through the channel* from and to all parts of the world. And whereas the ſaid Lighthouſe was preſerved and kept up for ſeveral years notwithſtanding the *great force and violence* of the *wind* and *ſea* (to which it was expoſed) until the late dreadful ſtorm in November 1703, when the ſame was blown down and deſtroyed: and whereas it was found by experience that the ſaid Lighthouſe (during the ſtanding thereof) was of public uſe and benefit to this kingdom, a means to preſerve her Majeſty's ſhips of war, and the ſhipping, lives and eſtates of her ſubjects.——And foraſmuch as the ſpeedy rebuilding the ſaid Lighthouſe is *abſolutely neceſſary* for avoiding the dangers attending the trade and navigation of this kingdom; and in regard the ſame work is of great *charge*, *hazard and expence*, and all due and proper *encouragement ought to be given thereunto*; to the end therefore that the ſaid *Maſter*, &c. may be encouraged to new-erect and build, or cauſe to be new-erected and built the ſaid Lighthouſe with all convenient ſpeed, and conſtantly keep and maintain the ſame for the benefit of the navigation and trade of this kingdom, be it enacted, &c." It then proceeds to enact the payment of the duties above mentioned, and double on foreign veſſels " from and after the *kindling* or placing a light *uſeful for ſhipping* in the ſaid Lighthouſe."

30. UPON

30. UPON this foundation Captain LOVET engaged Mr. JOHN RUDYERD to be his engineer or architect and ſurveyor: and the event has ſhewn that he made a very proper choice; though it does not appear that Mr. RUDYERD was bred to any mechanical buſineſs, or ſcientifical profeſſion, being at that time a *Silk Mercer* who kept a ſhop upon *Ludgate Hill*, *London*; nor do we find that in any other inſtance he had diſtinguiſhed himſelf by any mechanical performance before or after: yet this is no proof but that he might have made theſe kind of ſubjects his private amuſements; and it is indeed true, that a natural genius with very ſlender experience, will go much further in *Deſign*, than experience alone is capable of; but when genius and a competent experience are united in the ſame perſon, it is to be looked upon as a happy combination; and their productions likely to be the moſt complete and perfect. However, Mr. RUDYERD's want of perſonal experience, was in a degree aſſiſted by Mr. SMITH and Mr. NORCUTT, both ſhipwrights from the king's yard at *Woolwich*; who worked with him the whole time he was building the lighthouſe.

It is not very material now in what way this gentleman became qualified for the execution of this work; it is ſufficient that he directed the performance thereof in a maſterly manner, and ſo as perfectly to anſwer the end for which it was intended*. He ſaw the errors in the former building and avoided them; inſtead of a polygon he choſe a circle for the outline of his building, and carried up the elevation in that form. His principal aim appears to have been *uſe* and *ſimplicity*; and indeed, in a building ſo ſituated, the former could hardly be acquired in its full extent, without the latter. He ſeems to have adopted ideas the very reverſe of his predeceſſor; for all the unwieldy ornaments at top, the open gallery, the projecting cranes, and other contrivances, more for ornament and pleaſure, than uſe, Mr. RUDYERD laid totally aſide; he ſaw, that how beautiful ſoever ornaments might be in themſelves, yet when they are improperly applied and out of *place*; by affecting to ſhew a taſte, they betray ignorance of its firſt principle, *Judgment:* for whatever deviates from propriety is erroneous, and at beſt inſipid.

31. IN like manner as Mr. WINSTANLEY; Mr. RUDYERD alſo, after the completion of his work, publiſhed a print entituled *a Proſpect and Section of the* LIGHTHOUSE *on the* EDYSTONE ROCK *off of* PLYMOUTH; and he dedicated it to *Thomas Earl of* PEMBROKE, then *Lord High Admiral of Great Britain and Ireland*; with this motto, *Furit natura coercet ars.* The drawing by B. LENS, the engraving by I. STURT, both eminent artiſts of their time. This print I ſuppoſe to be very ſcarce, not having ſeen any other but the ſingle copy I have in my own poſſeſſion.

* Since writing the above, on peruſal of the MSS. by my valuable and learned friend the Rev. Mr. MICHELL, he has communicated to me an anecdote concerning Mr. RUDYERD, when I leaſt expected it: and as it is in itſelf curious, and comes ſo well authenticated, I will give it a place here; and perhaps it will come in better by way of note, than by being interwoven in the context:

The following particulars Mr. MICHELL had often heard his father repeat in his life-time, of this Mr. RUDYERD. They were both born in *Cornwall*; and his father being 18 years old when Mr. RUDYERD's Lighthouſe was begun, was at a time of life when he was likely to pick up the current ſtories of the times; as well as ſufficiently in the way to hear them, from his ſituation in the neighbourhood. ——According to the late Mr. MICHELL's account, Mr. RUDYERD's father and mother were of the loweſt rank of day-labourers, with a large family of children; and in as low repute in all other reſpects, as in point of rank; being looked upon as a worthleſs ſet of ragged beggars, whom almoſt nobody would employ, on account of the badneſs of their characters. *Our* Mr. RUDYERD, however, was from a child of a very different diſpoſition from the reſt; born with a good head, and an honeſt and a good heart, in ſhort the very reverſe of the reſt of the family, ſo that he was conſidered by them as a ſullen boy; as he would not aſſociate with them in going out upon their pilfering ſchemes; and probably on that account, as hath been ſuppoſed, he ran away from them; and by good luck, and from ſomething promiſing in his aſpect, got into the ſervice of a gentleman, ſuppoſed at *Plymouth*; and in this ſtation he appeared to ſo much advantage to his maſter, and became ſo great a favourite with him, that he gave him the opportunity of reading, writing, accounts and mathematics; in all which he made a very ready and great progreſs; and afterwards his maſter aſſiſted him very greatly in life, by procuring him ſome employment that raiſed him above the rank of a ſervant, and laid the foundation of his future ſucceſs in the world. ——The above account ſtrongly evinces that though education and example may do much; yet that there is ſomething in natural diſpoſition, that is not totally to be eradicated by education. Had Mr. RUDYERD's parents been of the moſt amiable character, if one of their children had turned out the reverſe, who would have wondered? We ſhould readily have explained it, that it aroſe from ill impreſſions from without: but the wonder in this caſe is, that in ſpite of all the force of evil example, here is a mind capable of emancipating itſelf, by the moſt violent of all remedies, that young people generally take, that of ſeparation from parents and houſhold by *flight*.

32. THE

32. THE Plate N° 6 is an orthographic elevation and ſection of Mr. RUDYERD's Lighthouſe. The *manner* of it, is herein copied, on account of the compendium thereby ſuggeſted; which ſhews part of the outſide and part of the inſide, ſo as to be at once, both an elevation and a ſection; this ſeems worthy of imitation, as it avoids a greater multiplicity of deſigns than the ſubject neceſſarily requires: but the proportions of the ſeveral parts of the ſtructure, are deſigned and drawn from freſh materials.

33. WHETHER it was owing to a kind of indolence, that ſome ingenious men are ſubject to, or to want of health, that we hear nothing more of Mr. RUDYERD after the publication of this print, does not now appear: I am rather inclined to ſuppoſe the latter; for had he continued in health and vigour, even if he had ſome ſlight *turn* of the former kind, yet the eminent abilities he ſhewed in this building, after finiſhing it with *eclat*, muſt have called him forth to the public ſervice on ſome other ſubject. I therefore muſt conclude, that even when the deſign for this print was prepared for the engraver, Mr. RUDYERD's application muſt have been ſlackened by want of health; and that the drawing muſt have been compiled from ſome ſketch or ſketches of the building made *antecedent* to its execution: becauſe in many particulars, it deviates from the proportions the building actually had; as fully appeared when there was occaſion to examine it, by after ſurveyors: and that, in ſome particulars, which could not afterwards be changed, nor in reality were they. Yet as what is written upon the face of Mr. RUDYERD's print, is the only piece of writing of *his* that has been preſerved, it will be proper to inſert a tranſcript of it, pointing out by notes the principal inaccuracies thereof.

34. " THIS *Edyſtone Rock* lyeth 3 leagues S. E. and N. W. of *Ram Head**, and four leagues from *Plymouth*. The building was begun in July 1706; a light put up thereon and made uſeful the 28th July 1708, and compleatly finiſhed in 1709. The rock *ſtives* from E. to W. 10 feet 11 inches in 24 feet, which is the diameter of the foundation†: 25 feet 6 inches is the largeſt circle that can be drawn upon the rock ‡. The face of the rock is divided into ſeven equal aſcents. There are 36 holes cut into the rock, from 20 to 30 inches deep; 6 inches ſquare at top, narrowing to 5 inches at 6 inches deep, from thence ſpreading and flatting to 9 by 3 at the bottom. They are all cut ſmooth within, and with great diſpatch (though the ſtone was harder than any marble or ſtone thereabouts) with engines for that purpoſe. Every cramp or bolt was forged exactly to the bigneſs of the hole it was deſigned for; they weighing from 2 cwt to 5 cwt each, according to their different lengths and ſubſtances§. Theſe bolts ſerved to tye the ſolid to the rock."

He mentions further in the literal references, that the outſide timbers (ſince called the *uprights)* were ſeventy-*two* in number; and ſo indeed they might have been *intended*, but the real number was ſeventy-*one*.

35. AS nothing would ſtand upon the ſloping ſurface of the rock without artificial means to ſtay it; Mr. RUDYERD judiciouſly concluded, that if the rock was reduced to level bearings, the heavy bodies to be placed upon it, would then have no tendency to ſlide; and this would be the caſe, even though but

* It is ſuppoſed that by ſome error in the tranſcriber or engraver, theſe bearings ſhould have been S. b. E. and N. b. W.; for then they will agree tolerably with Mr. WINSTANLEY's account, and with the variation of the compaſs at that time. The diſtances are doubtleſs according to vulgar reckoning.

† The diameter of this Lighthouſe upon its baſe could not exceed 23 feet 4 inches, as I have fixed it; which I conclude from the extent of the work upon the ſurface of the rock, by which it was reduced into ſteps or level bearings.

‡ The diameter of the baſe of the preſent Lighthouſe is 26 feet, nor does its circumference any where come nearer the border than one foot, ſo that a circle of 28 feet, which is 2 feet and 6 inches larger than Mr. RUDYERD deſcribes, may in reality be drawn upon the rock: but the baſe was ſomewhat enlarged by cutting off the top of the rock in 1756.

§ Several of the bolts, or, as ſince called, *branches*, here deſcribed, were cut out of the rock in the year 1756; and found to be very different in dimenſions and weight from what is here deſcribed; which ſeems rather what was intended before the work was begun, than what really was done, as already hinted. See the detached figure of one of them in Plate N° 7. The *aſcents* were in reality very *unequal*.

imperfectly

imperfectly executed; for the ſliding tendency being taken away from theſe parts that were reduced to a level, the whole would be much more ſecurely retained by the iron bolts or branches, than if for the retention of the whole, they had depended entirely upon the iron-work; as manifeſtly appears to have been the caſe with the building of Mr. WINSTANLEY.——According to Mr. RUDYERD's print, the inclined ſurface of the rock was intended to have been reduced to a ſet of regular ſteps, which would have been attended with the ſame good effect, as if the whole could have been reduced to one level; but in reality, from the hardneſs of the rock, the ſhortneſs and uncertainty of the intervals in which this part of the work muſt have been performed; and the great tendency of the *Laminæ* whereof the rock is compoſed, to riſe in *ſpawls*, according to the inclined ſurface when worked upon by tools, urged with ſufficient force to make an impreſſion; this part of the work, that is, the *ſtepping* of the rock, has been but imperfectly performed, though in a degree that ſufficed.

36. THE holes made to receive the iron branches, appear to have been drilled into the rock by *Jumpers**, making holes of about 2 ½ inches diameter; the extremities of the two holes forming the breadth for the branch, at the ſurface of the rock, were about 7 ½ inches; and theſe holes were directed ſo that at their bottoms they ſhould be ſeparated ſomewhat better than an inch more, that is, ſo as to be full 8 ½ inches. In the intermediate ſpace, a third hole was bored between the two former; and then if the three holes were broke into one, by ſquare-faced *Pummels*, this would make the holes ſufficiently ſmooth and regular†. By this means he obtained holes of a dovetail ſhape, being 2 ½ inches wide, 7 ½ broad at top, 8 ½ at bottom, and 15 and 16 inches deep; and, as theſe could not be made all alike, every branch was forged to fit its reſpective hole. The main pieces of each branch were about 4 ½ inches broad at the ſurface of the rock, and 6 ½ at the bottom; and this being firſt put down into the hole, the ſpace left for a key would be 3 inches at top, and two inches at bottom, which would admit it to be driven in ſo as to render the whole firm, and the main branch fixed like a dovetail or *Lewis*.——I ſhall now proceed to deſcribe the manner of filling the interſtices with lead, ſo as to make all ſolid, and exclude the water.

37. THE holes being each finiſhed, and fitted with their reſpective branches, and cleared of water, a conſiderable quantity of melted tallow was poured into each hole: the branch and key being then heated to about a *blue* heat, and being put down into the tallow, and the key firmly driven; by theſe means, all the ſpace unfilled by the iron, would become full of tallow, and the overplus made to run over: when this was done, all remaining hot, a quantity of coarſe pewter, being made red hot in a ladle, and run into the chinks, as being the heavieſt body, would drive out the ſuperfluous melted tallow: And ſo effectually had this operation ſucceeded, that in thoſe branches which were cut out in 1756, and had remained faſt, the whole cavity had continued ſo thoroughly full, that not only the pewter, but even in general, the tallow remained apparently freſh: and when the pewter was melted from the irons, the ſcale appeared upon the iron, as it had come from the ſmith's forge, without the leaſt ruſt upon it.——I have been the more minute in this deſcription, becauſe it ſhewed the perfection of this method of fixing iron-work into ſtone, even in the caſe, where the ſalts of ſea water are ever in readineſs to penetrate, could they have found the leaſt admiſſion.

38. ALL the iron branches which are ſhewn, as I found them, in Plate N° 7, having been fixed in the manner abovementioned; they next proceeded to lay a courſe of ſquared oak balks, lengthwiſe upon the loweſt ſtep, and of a ſize to reach up to the level of the ſtep above.——Then a ſet of ſhort balks were laid croſſways of the former, and upon the next ſtep compoundedly, ſo as to make good up to the ſurface of the third ſtep.——The third *ſtratum* was therefore again laid lengthwiſe, and the fourth croſſways, &c. till a baſement of ſolid wood was raiſed, two complete courſes higher than the higheſt part

* The inſtruments ſo called are well-known tools for boring holes in the harder kind of ſtone.

† In this way I tried the making dovetail holes, and found the method very practicable: and in this way afterwards, in the courſe of the work we made various temporary affixtures to the rock; and made the *Lewis* holes in the Moor-ſtones.

of the rock; the whole being fitted together, and to the rock as close as poſſible, and the balks, in all their interſections with each other, trenailed together. They were alſo fitted to the iron branches where they happened to fall in; for the branches do not ſeem to have been placed with any complete regularity or order, but rather where the ſtrength and firmneſs of the rock pointed out the propereſt places for fixing them: they were however to appearance diſpoſed, ſo as to form a double circle, one about a foot within the circumference of the baſement, and the other about three feet within the former; beſides which, there were two large branches fixed near the center, for taking hold of the two ſides of a large upright piece of timber, which was called the *Maſt*; by which two branches, it was ſtrongly fixed down; and being ſet perpendicular, it ſerved as a center for guiding all the reſt of the ſucceeding work.

The branches were perforated, in their reſpective upper parts, ſome with three, and ſome with four holes; ſo that, in every pair (collectively called a branch) there would be at a medium ſeven holes; and as there were at leaſt 36 original branches, there would be 252 holes, which were about $\frac{1}{4}$ of an inch in diameter; and, conſequently, were capable of receiving as many large-bearded ſpikes or *Jag-bolts*, which being driven through the branches into the ſolid timber, would undoubtedly hold the whole maſs firmly down; and the great multiplicity of trenails in the interſections, would confine all the *ſtrata* cloſely and compactly together.

39. I CANNOT omit here to remark, that though the inſtrument we now call the *Lewis*, is of an old date; yet, ſo far as appears, this particular application of that idea, which Mr. RUDYERD employed in fixing his iron branches firmly to the rock, was made uſe of for the firſt time in this work: for though Mr. WINSTANLEY mentions his having made 12 holes, and fixed 12 great irons in the rock, in his firſt year's work; yet he gives no intimation of any particular mode of fixing them, but the common way with lead: and the ſtump of one of the great irons of Mr. WINSTANLEY's, that was cut out in the courſe of the work of the ſummer 1756, was fixed in that manner; but we remarked, that the low end of this bar or ſtanchion was a little *club-ended*, and that the hole was ſomewhat *under-cut*; ſo that, when the lead was poured in, the whole together would make a ſort of dovetail engraftment: however, when theſe irons, by great agitations became looſe, and the lead yielded in a certain degree, they would be liable to be drawn out; as the orifice by which they entered, muſt have been large enough to receive the iron club. ——Mr. RUDYERD's method, therefore, of *keying* and ſecuring, muſt be conſidered as a material acceſſion to the practical part of *Engineery*; as it furniſhes us with a ſecure method of fixing *ring*-bolts and *eye*-bolts, ſtanchions, &c. not only into rocks of any known hardneſs; but into piers, moles, &c. that have already been conſtructed, for the ſafe mooring of ſhips; or fixing additional works, whether of ſtone or wood.

40. IN this way, by building *ſtratum ſuper ſtratum*, of ſolid ſquared oak timber, which was of the beſt quality*, Mr. RUDYERD was enabled to make a ſolid baſement of what height he thought proper: but in addition to the above methods, he judiciouſly laid hold of the great principle of Engineery, that WEIGHT *is the moſt naturally and effectually reſiſted by* WEIGHT. He conſidered, that all his joints being pervious to water, and that though a great part of the ground joint of the whole maſs, was in contact with the rock, yet many parts of it could not be accurately ſo; and therefore, that whatever parts of the ground joint were not in perfect contact, ſo as to exclude the water therefrom, though the ſeparation was only by the thickneſs of a piece of poſt-paper, yet if capable of receiving water in a fluid ſtate†, the action of a wave upon it edgewiſe, would upon the principles of *Hydroſtatics*, produce an equal effect towards lifting it upwards, as if it acted immediately upon ſo much *area* of the bottom, as was not in cloſe contact.

* It is ſaid that all the timber uſed in this building was *winter felled*.

† When water is received into the pores of wood or ſtone and other ſolid bodies, I do not conſider it as in a ſtate of fluidity.

41. THE

41. THE more effectually therefore to counteract every tendency of the ſeas to move the building, in any direction, he determined to interpoſe *ſtrata* of *Corniſh Moor-ſtone* between thoſe of wood; and accordingly having raiſed his foundation ſolid, two courſes above the top of the rock, he then put on five courſes, of one foot thick each, of the Moor-ſtone*. Theſe courſes were as well jointed as the workmen of the country could do it; to introduce as much weight as poſſible, into the ſpace to contain them: they were however laid without any cement; but it appears that iron cramps were uſed to retain the ſtones of each courſe together, and alſo upright ones to confine down the outſide ſtones; for though Mr. RUDYERD makes no mention of the cramps, I learnt this circumſtance by converſing with a perſon actually employed in the preparation of the ſtone; as will be more fully ſtated hereafter.

42. WHEN five feet of Moor-ſtone were laid on, which according to the dimenſions would weigh 120 tons; he then interpoſed a couple of courſes of ſolid timber as before; the uſe of which was plainly for the more effectual and ready faſtening of the outſide uprights to the ſolid, by means of *Jag*-bolts†, or ſcrew-bolts; and that theſe bolts might the more effectually hold in the wood, in every part of the circle (which could not be the caſe with timbers lying parallel to each other, becauſe in two points of the circle oppoſite to each other, the timbers would preſent their ends towards the bolt) he encompaſſed thoſe two courſes with circular, or what is technically called *compaſs* timbers, properly *ſcarphed* together, and *breaking joint* one courſe upon the other. We muſt not however ſuppoſe, that theſe courſes were compoſed wholly of circular timbers to the center, but that the circles of compaſs timbers on the outſide, were filled up with parallel pieces within; and that the compaſs timbers were, in the moſt favourable points, jag-bolted to the interior parallel pieces.

The two uppermoſt courſes, after clearing the rock, and before the five Moor-ſtone courſes came on, were furniſhed with compaſs timbers, as well as ſome others below, which are alſo diſtinguiſhed in Plate N° 6, exhibiting the orthographical elevation and ſection beforementioned of Mr. RUDYERD's Lighthouſe, as it ſtood antecedent to its demolition by fire in the year 1755.

The two courſes of wood above the Moor-ſtone courſes beforementioned, terminated the *entire ſolid* of the baſement; for a *Well Hole* was begun to be left upon theſe courſes for ſtairs in the center, of ſix feet 9 inches in the ſquare; and hereupon was fixed the entry door, or rather, one courſe lower, making a ſtep up, juſt within the door; in conſequence of this, the entire ſolid terminated about nine feet above the higher ſide of the baſe, and 19 feet above the lower ſide thereof‡.

The detached ſketch Fig. 2, Plate N° 6 gives the plan of the five Moor-ſtone courſes included in the entire ſolid, compiled from old working draughts, that appear to have been given out by Mr. RUDYERD during the courſe of the work, for forming and fixing theſe courſes: the continued lines repreſent the joints of courſe N° 1; and the dotted lines, thoſe of courſe N° 2, which ſhew how they broke joint upon one another: and the courſes being alternately of theſe different figures, they would mutually break joint in the ſame manner.——In the original drawings, they were repreſented by black lines and red lines. ——From hence it appears, that though no cramps are repreſented, yet beſides the maſt in the center, there are ten holes of about two inches diameter each; eight of them forming an octagon round the center, and two more in two of the oppoſite ſtones that abut upon the maſt: and I have no doubt, but that the uſe of thoſe holes was for the paſſage of iron bars or bolts, which firmly laying hold of the two compaſs

* In Mr. RUDYERD's print ſix courſes of Moor-ſtone are exhibited in this place; but in reality there were but five, as many occaſions of repair have afterwards evinced; which is a further argument, that the print was compiled from a deſign or ſketches made *before* the building was erected.

† *Jag* or *barbed* bolts or ſpikes, are ſuch as with a chiſſel have a beard raiſed upon their angles, ſomewhat like that of a fiſh-hook, ſo that when driven forcibly into the wood, thoſe beards, by laying hold, oppoſe their being drawn out again.

‡ The difference in the declivity of the baſe from that mentioned § 34 is to be attributed to the difference betwixt the original deſign and the execution.

courſes

courſes under the Moor-ſtone, then paſſing through the five Moor-ſtone courſes, and laſtly through the two compaſs courſes above the Moor-ſtone, would, beſides the upright cramps, be a further means of tying all thoſe nine courſes firmly together as one ſolid; that ſolid being firmly tied by the trenails to the courſes below, and thoſe ultimately to the branches. This mode of binding appears ſtill the more probable, as in Mr. RUDYERD's copper-plate repreſentation, there is the appearance of iron bars proceeding through all the courſes of ſtone, and to the termination of the ſolid at the ſtore-room floor; but of theſe I find no traces either in the ſaid drawings, or the building above the entire ſolid, further than has been already deſcribed.

43. IN Mr. WINSTANLEY's houſe, the entry was from the rock into an internal ſtaircaſe, formed in the caſing mentioned in the work of the 4th year, upon the S. E. ſide; he therefore needed only a few external ſteps, as ſhewn in Plate N° 5. But Mr. RUDYERD's entry door, being full eight feet above the higheſt part of the rock, he would conſequently need a ladder. This he made of iron of great ſtrength; and being open, whenever the ſeas broke upon this ſide of the houſe, they readily found their paſſage through, without making any very violent agitation upon it.

44. THE two compaſs courſes terminating the entire ſolid, having been eſtabliſhed, as already mentioned, he again proceeded with five Moor-ſtone courſes; of which Fig. 3 is the plan, Plate N° 6, nearly the ſame as the former; allowing for the neceſſary difference, reſulting from there now being a central well hole for the ſtairs, and a paſſage from the entry door, as deſcribed, to the well hole: this paſſage was 2 feet 11 inches wide, and, as it appears, took up the whole height of the five courſes. The weight of theſe five courſes, according to the dimenſions, amounted to 86 tons.

He then again proceeded with two compaſs courſes, covering the door head and paſſage, ſo as now to leave no other vacuity, than the well hole; and upon theſe he laid four Moor-ſtone courſes*, the weight of which amounted to 67 tons. He then proceeded with two compaſs courſes, and after that, with beds of timber croſs and croſs, and compaſs courſes interpoſing; and laſt of all, with one compaſs courſe, upon which he laid a floor over all, of oak plank of three inches thick, which made the floor of the ſtore-room.

45. THE height of this floor above the bottom of the well, was near 18 feet; above the foot of the maſt 33 feet; above the rock on the higher ſide 27 feet; and above the foot of the building on the lower ſide 37 feet. In all this height, no cavity of any kind was intended for any purpoſe of depoſiting ſtores, &c.——From the rock to the bottom of the well, all was ſolid, as we have ſhewn; but as the building increaſed in height, and conſequently was more out of the heavy ſtroke of the ſea, a leſs degree of ſtrength and ſolidity would be equivalent to the former, and therefore admit of the convenience of a ſtaircaſe *within* the building, with a paſſage into it: which laſt, being made upon the eaſt ſide, would be withdrawn from the heavy ſhock of the ſeas from the ſouth-weſt quarter, and the rock being there higheſt, the aſcent by the iron ſtair upon the outſide, would be the leaſt; the whole therefore to the height of the ſtore-room floor, as abovementioned, having been made with all poſſible ſolidity, was denominated *the ſolid*.

46. THE height of Mr. RUDYERD's ſtore-room floor, was fixed as high as the floor of Mr. WINSTANLEY's *ſtate*-room, which was over his ſtore-room†: and as many were doubtleſs ſtill living who had ſeen and examined Mr. WINSTANLEY's Lighthouſe, during the four years that it ſtood in a finiſhed ſtate; and as in that time there would be an opportunity of knowing from experience, to what height the unbroken water of the waves mounted in bad weather; we may very well ſuppoſe, that Mr. RUDYERD regulated the height of his ſolid from that information.

* Mr. RUDYERD's deſign ſhews five courſes; but this is clearly a miſtake, as might be ſeen at any time, by counting them in the ſtaircaſe.

† See § 24 and Plate N° 5.

47. WE

47. WE have already ſeen, that the two compaſs courſes of wood, which capped the firſt bed of moorſtone, and terminated the entire ſolid, were forcibly ſcrewed down by ten large iron bars or bolts to the beds of timber below the moorſtone, and theſe by the trenails and branches to the rock. We muſt ſuppoſe this precaution to have been taken, to prevent any derangement from the heavy ſtrokes of the ſea in ſtorms and hard gales, which were liable to happen in the very fineſt part of the ſeaſon, before there was any proper opportunity of connecting the upper part of the work with the lower, by means of the upright timbers, that were to form the outſide caſe; becauſe, till the work was brought to that height, there could be no proper means of beginning to fix them: and as we do not find any traces or mention of binding the upper courſes with the lower, after the ſtaircaſe was ſet forward; we muſt ſuppoſe that the outſide caſing had been then begun from the rock, and carried on progreſſively, ſo as to become a *bond* of the upright kind: for, all ſuch timbers as were high enough, having been ſcrewed faſt to the compaſs courſes, would be thereby ſecured to the lower courſes; otherwiſe, from what I have myſelf experienced of the ſituation, I ſhould have expected, that whenever the two courſes of compaſs timber were put upon the ſecond bed of moorſtone, if a hard gale ſhould have come on at South-Weſt, it would not only have lifted up and carried away the timber beds, but poſſibly would have deranged the moorſtone courſes; notwithſtanding the upright cramps to the outſide ſtones.

42. THE ſolid being in this manner completed, the upper part of the building comprehending four rooms, one above another, was chiefly formed by the outſide upright timbers; having one *Kirb* or circle of compaſs timber at each floor, to which the upright timbers were ſcrewed and connected; and upon which the floor timbers were reſted. The uprights were alſo jag-bolted and trenailed to one another, and in this manner, the work was carried on to the height of 34 feet above the ſtore-room floor; and there terminated by a planking of three inches thick, which compoſed the roof of the main column, as well as ſerved for the floor of the lantern, and of the balcony round it.

43. THUS the main column of this building conſiſted of one ſimple figure, being an elegant *Fruſtum* of a cone, unbroken by any projecting ornament, or any thing whereon the violence of the ſtorms could lay hold; being, excluſive of its ſloping foundation, 22 feet 8 inches upon its largeſt circular baſe; 61 feet high above that circular baſe; and 14 feet 3 inches in diameter at the top: ſo that the circular baſe was ſomewhat greater than one-third of the total height, and the diameter at top was ſomewhat leſs than two thirds of the baſe at the greateſt circle.

44. THE junction of the upright timbers upon each other, was by means of *Scarfs*, as they are technically called in ſhip-building and carpentry; that is, the joining of timbers end to end by overlapping The timbers were of different lengths from 10 to 20 feet, and ſo ſuited, that no two joinings or ſcarfs of the uprights might fall together. The number of uprights compoſing the circle was the ſame from top to bottom; and their number being 71, their breadth at the bottom would be one foot nearly; their thickneſs there was 9 inches; and as they diminiſhed in breadth towards the top, they alſo diminiſhed in thickneſs. The whole of the outſide ſeams was well caulked with *Oakum*, in the ſame manner as in ſhips; and the whole *payed* over with pitch, conſequently upon a near view, the ſeams running ſtraight from top to bottom, in ſome meaſure reſembled the *fluting* of columns; which in ſo ſimple a figure, could not fail to catch the attention of the beholder, and prove an agreeable engagement of the eye.

The whole of the building was indeed a piece of *Shipwrightry:* for it is plain from the preceding account, that the interpoſed beds of moorſtone had nothing to do with the frame of the building, it being entire and complete excluſive thereof: the beds of moorſtone could therefore only be conſidered in the nature of ballaſt, and amounted, from what has been before ſtated in the whole, to the weight of above 270 Tons.

45. ALL the windows, ſhutters and doors were compoſed of double plank, croſs and croſs, and *clinked* together; which falling into a *rabbet*, when ſhut, their outſide formed a part of the general

 ſurface,

ſurface, like the port-holes in a ſhip's ſide; without making any unevenneſs or projection in the ſurface. ——There were however, two projecting parts terminating this *Fruſtum*; one at the top, and the other at the joining with the rock; the utility of which ſeems to render them indiſpenſable. They were each of them a projection of about 9 inches. The top projection, which is in the nature of a cornice, conſiſted of a ſimple *bevil*, and the uſe of it was very great; for in time of ſtorms and hard gales of wind, when, according to the accounts of Mr. WINSTANLEY's building, the broken ſea riſes to a far greater height than the whole ſtructure, it would be likely to break the windows of the lantern, unleſs there was ſomething to throw it off, as *their* uſe does not admit of any defence by ſhutters. Therefore Mr. RUDYERD applied this ſimple cornice, judging it ſufficient to have the effect of throwing off the ſea in time of ſtorms; and yet not of ſo much projection, as that the ſea at the height of 71 feet above the foot of the building could have power enough to derange it.

The bottom projection, which has been called the *Kant*, and which fills up the angle formed between the uprights and the ſloping ſurface of the rock, ſo as to guard the foot of the uprights from that violence of action which the waves naturally exert when driven into a corner, was certainly a very uſeful application: but whether it was originally conſtructed by Mr. RUDYERD himſelf, or was applied ſome time after, upon finding a want thereof, is at preſent uncertain.——I am rather inclined to think the latter, and that for two reaſons: Firſt, there is nothing of the kant ſhewn in Mr. RUDYERD's print of the building; the feet of the uprights being ſhewn as applied to the naked ſteps, both in ſection and elevation, without any thing of the kant; but as there were in reality many other deviations, I am more ſtrongly inclined to think it was not there, upon the firſt completion, for the ſecond reaſon; that is, becauſe the iron ſtanchions or branches, that were let into the rock by way of confining the kant in its place, were not fixed into the rock in the method of *Key* and *Dovetail*, as Mr. RUDYERD had done all his principal and original branches; but were fixed in with club ends, in the way of Mr. WINSTANLEY's irons: whereas a workman verſed in Mr. RUDYERD's method, would not only find it much more firm, but even more eaſy in the execution, than the old method.

46. UPON the flat roof of the main column, as a platform, Mr. RUDYERD fixed his lantern, which was an octagon of 10 feet 6 inches diameter externally. The mean height of the window frames of the lantern above the balcony floor, was nearly nine feet, ſo that the elevation of the center of the light above the higheſt ſide of the baſe was 7: feet; that is, lower than the center of Mr. WINSTANLEY's ſecond lantern by ſeven feet; but higher than that of his firſt by 24 feet.——The width of Mr. RUDYERD's lantern was however nearly the ſame as that of Mr. WINSTANLEY's ſecond: but inſtead of the towering ornaments of iron work, and a vane that roſe above the top of the cupola no leſs than 21 feet, Mr. RUDYERD judiciouſly contented himſelf with finiſhing his building with a round ball, of 2 feet 3 inches diameter, which terminated at three feet above the top of his cupola. The whole height of Mr. RUDYERD's lantern, including the ball, was no more than 21 feet above his balcony floor; whereas that of Mr. WINSTANLEY, including the iron ornaments, was above forty.

The whole height then of Mr. RUDYERD's Lighthouſe, from the loweſt ſide to the top of the ball, was 92 feet, upon a baſe of 23 feet 4 inches, taken at a medium between the higheſt and loweſt part of the rock that it covered.

47. IN the elevation of this building, contained in plate N° 6, the rock is repreſented at the low water, as ſeen from the South, in the manner I found it in the year 1756; to which, the preſent plate of the elevation of his Lighthouſe is adapted, from the beſt documents concerning it that have come into my hands.

A ſhews the rock.——B the landing place.

a a the ſteps or flats to which the rock was reduced.——b b the branches.——c c, &c. floors of wood laid lengthwiſe of the ſteps.——d d floors laid croſsways of the ſame.——e e courſes of compaſs timber.

——D five

——D five courſes of moorſtone, which with two courſes of compaſs timber marked E completed the entire ſolid, to the top of which led

F the iron ladder to G the entry door, and through GH the entry or paſſage into——H I the well-hole for the ſtair caſe.——K L the maſt.——M five courſes of moorſtone, the height of which compoſed the entry or paſſage.

N two beds of compaſs timber, making good the paſſage to the ſtairs.

O four beds of moorſtone, capped with two beds of compaſs timber, after which ſucceeded courſes of timber alternately *croſs* and *croſs*, with compaſs courſes interpoſed as ſhewn in the ſection.

P Q ſhew the upright timbers, as they appeared externally, being 71 in number.

p q the ſame in the upright ſection.

I the ſtore-room floor, and R the door of the ſtore-room; which was ſo much further to the North than the entry, that when caſks and ſtores were drawn up perpendicularly by a tackle, ſuſpended from above, they would clear the iron ladder.

S the ſtate-room.——T the bed chamber.——V the kitchen.——W the balcony——X the lantern.——Y the lantern door into the balcony; and—Z the cupola and ball.

f f four curved pipes for venting the ſmoke from the candles in the lantern.

g the top of the copper funnel, which paſſed through the lantern, from the kitchen fireplace which was of brick.

h the upper bevil, or projection by way of cornice for throwing off the ſea, to prevent it from breaking the lantern windows in time of ſtorms; which was neceſſary, though the panes were of *ground Glaſs*, on account of ſtrength.

i knees to ſtrengthen the junction of the uprights with the balcony floor, and alſo in part to ſupport the weight of the lantern.

k k k the original kirbs of compaſs timbers to form the uprights to a circle, and ſupport the weight of the floors.

m m m *Kirbs* applied of late years for ſtrengthening the frame of the building.

n n the kant at the foot of the uprights, and o o one of the ſtanchions by which the kants were faſtened down.

48. SUCH a platform as the balcony round the lantern was abſolutely neceſſary, on account of cleaning the outſide of the windows; which gather a ſaline incruſtation upon them, every ſtorm and hard gale of wind; and the rails not only ſerved the purpoſe of preventing perſons from tumbling over, but were of uſe in hoiſting the flag, as a ſignal to the ſhore, that ſomething was wanted. This is ſufficiently explained by Plate N° 5: but the flag-ſtaff was not always in one fixed place, as there repreſented; as it could occaſionally be *laſhed* to the moſt proper part of the rails for its exhibition to the ſhore; and to ſuit the wind, ſo as that the flag might fly clear of the building.

Alſo inſtead of any cranes as ſhewn by Mr. WINSTANLEY, a pair of *tackle* blocks were occaſionally, when wanted, hooked to the hand-rail of the balcony, and taken in when done with; for there was little chance of getting any thing into the houſe, except when a boat could lie in the Gut, and then it might be landed directly into the ſtore-room.

The chink at p is the place where a part of a chain, apparently one of Mr. WINSTANLEY's crane chains, was jammed in ſo faſt on the deſtruction of that Lighthouſe, that it remained ſo during the whole continuance of Mr. RUDYERD's Lighthouſe, and was ſhewn as one of the curioſities of the place.

49. I HAVE endeavoured to deſcribe this building with all poſſible minuteneſs, becauſe it affords a great, and a very uſeful leſſon to future Engineers. We are ſure that a building ſuch as Mr. WINSTANLEY's, was not capable of reſiſting the utmoſt fury of the ſea; becauſe, in four years after its completion, it was totally demoliſhed thereby: but Mr. RUDYERD's building having ſuſtained the repeated attacks of that element in all its fury, for upwards of 46 years after its completion; and then being

being deſtroyed, not by water, but by fire; we muſt conclude, it was of a conſtruction capable of withſtanding the greateſt violence of the ſea in *that* ſituation. And by withſtanding it *there*, this Lighthouſe proves the practicability of a ſimilar erection in any like expoſure in the known world: for, having attentively read and conſidered what is contained in the reſpective voyages of ANSON, BYRON, COOK, and PHIPPS, the moſt ſcientific navigators that modern times have produced, I do not find in all their accounts, ſuch an expoſure to the ſea's uttermoſt violence, as at the *Edyſtone Rocks*.

50. Mr. RUDYERD informs us, as abovementioned, that a light was put up in this building the 28th July 1708, and that it was completely finiſhed in 1709*. The means of exhibiting this light, would have been not only curious, but uſeful, had it been handed down to us. The beſt information that I have been enabled to procure upon this point is, " that a light was exhibited from the houſe in a lantern, that was raiſed upon eight fir *Balks*, which butted upon the ſolid, and were weather-boarded with deal." ——At this time we muſt ſuppoſe that the ſolid was completed; and, in a great part, its exterior caſing alſo; but that this caſing was not got much above the ſolid: if therefore thoſe eight pillars were raiſed, ſo as to be capable of hoiſting a light above the floor of the third room; then, in the courſe of that ſummer, they might very well perfect the two low rooms, for lodging the lightkeepers, during the enſuing winter; and finiſh the two remaining rooms and principal lantern, the next ſeaſon of 1709, as Mr. RUDYERD relates; that being the fourth and laſt ſummer of the progreſs of that work.

51. THE following anecdote has been related to me by ſuch a variety of perſons, that I cannot doubt of its having ſome foundation in truth, though no mention has been made thereof by Mr. RUDYERD. The relation will therefore I truſt be acceptable to my readers, as it at once ſhews the great eſtimation in which this building has been held by foreigners, even ſuch as were, at the very time, enemies of this country.

LEWIS *the* XIV. being at war with England, during the proceeding with this building, a French privateer took the men at work upon the Edyſtone rock, together with their tools, and carried them to France; and the captain was in expectation of a reward for the achievement. While the captives lay in priſon, the tranſaction reached the ears of that monarch: He immediately ordered them to be releaſed, and the captors to be put in their place; declaring, that though he was at war with England, he was not at war with mankind; he therefore directed the men to be ſent back to their work with preſents; obſerving that the Edyſtone Lighthouſe was ſo ſituated, as to be of equal ſervice to all nations having occaſion to navigate the channel that divides France from England †.

52. I HAVE ſeen a paper in the hands of one of the preſent proprietors, upon which were put down the quantities of materials ſaid to have been expended in the conſtruction of this building: *viz.* 500 tons of ſtone; 1200 tons of timber; 80 tons of iron, and 35 tons of lead; and of trenails, ſcrews, and rack-bolts 2500 each ‡.

* This is further aſcertained by the following extract from the preamble of an act of the 8th of ANNE, chap. 17.

" And whereas the ſaid *Maſter, Wardens*, and *Aſſiſtants* (of TRINITY HOUSE) having a due regard to the ſafety and preſervation of the ſhipping and navigation of this kingdom, did ſoon after the paſſing of the ſaid act, (4th of ANNE, chap. 20.) cauſe the ſaid Lighthouſe to be begun, and to be rebuilt; and by the great care and diligence of the perſons employed therein, the ſaid work was carried on with ſuch expedition, that a light *uſeful for ſhipping* was placed therein on the 28th July 1708; and the ſaid Lighthouſe hath ſince, with much hazard and difficulty, and at a very great expence been fully built and completed, to the great ſatisfaction of the flag officers and commanders of her majeſty's fleet and ſhips of war, and of all others concerned in trade and navigation."

† Mr. RUDYERD remarks upon the face of his print, that " to expedite the work and to protect the workmen, theſe four men of war, at ſundry times, were appointed to this ſtation, *viz.* 1ſt, The *Roebuck* of 42 guns.——2d, The *Charles Galley* of 36.——3d, The *Amber's Prize* of 32.——4th, The *Albrow* of 24." Which appointment was probably in conſequence of the accident above related.

‡ This muſt be ſuppoſed the account of rough materials, otherwiſe the ſtone and timber muſt greatly exceed the real quantity.

CHAP.

CHAP. IV.

Containing Subſequent Tranſactions and Occurrences from the Finiſhing Mr. RUDYERD's *Lighthouſe, to the total Demolition thereof.*

53. FROM the time of finiſhing the Lighthouſe in 1709, we have no further particulars till about the year 1715, when Captain LOVET, the proprietor of the leaſe, under the Corporation of the *Trinity Houſe*, beforementioned, being deceaſed, his property was ſold at public biddings by a Maſter in Chancery, in conſequence of a decree and directions from that court: when it was purchaſed by three perſons, *viz.* ROBERT WESTON, Eſq; RICHARD NOYES, Eſq; of *Grays Inn*; and ——— CHEETHAM, Eſq; an Alderman of *Dublin*. The agreement of the purchaſers was to divide the leaſehold property thus acquired into eight ſhares, of which Mr. WESTON had three, Mr. NOYES two, and Mr. CHEETHAM three.

54. THIS houſe, we are told, ſtood in no need of any material repairs for ſome years; but in or about the year 1723, defects were diſcovered, which required great attention: for now it was firſt obſerved, that ſome parts of the uprights were decayed at the but ends, by means of a ſmall worm, which had eaten ſome inches into them, eſpecially thoſe on the loweſt ſide of the houſe. Hereupon the gentlemen proprietors appointed Mr. JOHN HOLLAND, then a foreman ſhipwright in his Majeſty's dock-yard at *Plymouth*, to ſurvey and direct the repairs; which he very judiciouſly did, from time to time, till he was advanced to the office of aſſiſtant builder in *Woolwich Yard:* on which occaſion, the overſeeing and conducting of the repairs was transferred to a creditable ſhipwright at Plymouth dock; upon whoſe reports of the ſtate of the building, from time to time, Mr. HOLLAND gave directions in what manner to proceed: but this not being ſo ſatisfactory to the proprietors, as when under the immediate inſpection and direction of Mr. HOLLAND; and ſome conſiderable repairs being neceſſary in the year 1734, Mr. HOLLAND, by leave of the Lords Commiſſioners of the ADMIRALTY, was ſent down to Plymouth to conduct the ſame.

This is the period when the ſtructure of that edifice, and the defects it was liable to, became better underſtood; for one of the gentlemen principally intereſted, followed Mr. HOLLAND to *Plymouth*, and reſiding there a conſiderable time, made many obſervations in his viſits to the building; and ſeeing how the works were carried on, formed ſuch a plan for the future conducting of this ſtructure, as might probably have preſerved it for a number of years, againſt the attacks of thoſe elements to which from its critical ſituation it was the moſt obviouſly expoſed †.

55. IN this place it may be proper to take notice of an experiment which was tried in 1734, to prevent the ill effects that might happen from the worm: and that was by covering the outſides of 15 pieces of the uprights, at the bottom of the houſe, with *copper*, and their inſides with lead; and two pieces were covered entirely with copper, as high as the worm deſtroyed: but I am informed, this did

† In this year Mr. HOLLAND made a very curious draught of the Lighthouſe, in which every one of the outſide upright timbers was diſtinctly repreſented; ſo that every one of them could numerically be referred to; and the places and nature of the ſcarfing or joinings diſtinguiſhed. This was done by ſuppoſing the whole of the uprights to be ſeparated at one particular joint, from top to bottom; and then all the reſt opened till they were brought into one plane: the figure thus formed would become a kind of *Evolute* of the ſurface of the whole building; and was peculiarly adapted to illuſtrate the experiments, reports and repairs that were then carrying on, and might from time to time thereafter be wanted or recommended: this draught diſtinctly repreſents the *kant* at the bottom; and hereby it was firſt known, that the real number of uprights was 71; and not 72 as had been before imagined.

not thoroughly anſwer expectation; for in 1744, one of thoſe pieces that was entirely coppered, was taken out, and found to be worm-eaten *.

56. THE latter end of 1744 after all the neceſſary repairs were finiſhed, there happened a dreadful ſtorm on the 26th September, which being from the Eaſt, tore away no leſs than 30 pieces of the uprights all together†; which in part made an opening into the ſtore-room: this diſaſter however, by great exertion, was entirely repaired by the 14th December following, under the inſpection and direction of Mr. JOSIAS JESSOP, then (and indeed until his death no more than) that ſpecies of foreman ſhipwright, called a *Quarter-man* in Plymouth dock. This perſon, whoſe modeſty and ingenuity cauſed him to be deſervedly reſpected by many, Mr. HOLLAND recommended to the proprietors to be their overſeer, which they ſtill rank among the eminent ſervices he did them‡.

Mr. HOLLAND, who had been promoted to be King's *Builder* at Deptford Yard, continued his good offices to the time of his death, which happened not till the year 1752; and then the execution of the important office of repairing this building, was ſolely intruſted to Mr. JESSOP, who diſcharged his duty herein, with the greateſt integrity, diligence and accuracy, till the calamity happened, which totally deſtroyed the building, and which could neither be foreſeen nor avoided.

57. IT ſeems that for many years after the eſtabliſhment of this Lighthouſe, it was attended by two men only; and indeed the duty required no more; as the principal part of that, beſides keeping the windows of the lantern clean (and in general the rooms) was the alternately watching *four hours*, and *four hours*, to ſnuff and renew the candles; each at the concluſion of his watch taking care to call the other and to ſee him on duty before he himſelf retired: but it happened, that one of the men was taken ill and died; and notwithſtanding the Edyſtone *Flag* was hoiſted, yet the weather was ſuch for ſome time, as to prevent any boat from getting ſo near the rocks as to ſpeak to them §.——In this dilemma, the living man found himſelf in an awkward ſituation; being apprehenſive that if he tumbled the dead body into the ſea, which was the only way in his power to diſpoſe of it, he might be charged with murder; this induced him for ſome time to let the dead corpſe lie, in hopes that the boat might be able to land and relieve him from the diſtreſs he was in.——By degrees the body became ſo offenſive, that it was not in his power to get quit of it without help; for it was near a month before the attending boat could effect a landing; and then it was not without the greateſt difficulty that it could be done when they did land. To ſuch a degree was the whole building filled with the ſtench of the corpſe, that it was all they could do

* It will now ſeem that this experiment of plate copper (which I have from the beſt authority) that did not ſucceed in preventing and deſtroying the worm, is not eaſily to be reconciled with the preſent practice of ſheathing ſhips bottoms therewith, which is held to be an effectual remedy, as being a poiſon to the worm: this we may however infer, that this, as well as many other good propoſitions, have been given up too haſtily: for though here was a trial of 10 years, yet the practice was condemned as *ineffectual* upon a *ſingle inſtance*.——On conſulting my ſcientifical friends reſpecting this fact, ingenious reaſons have been ſuggeſted, why the conſtant ſtate of immerſion that takes place in a ſhip's bottom, may more effectually convey the poiſon into the wood, than where it is forſaken by the ſea every tide; and even that the ſtrokes of the ſea may at the Edyſtone be ſo great as to waſh the poiſon out again from the wood, that in a ſituation of leſs violence could gradually and ſlowly inſinuate itſelf; and probably ſomething of this kind may have been the caſe: but on lately converſing with a very intelligent *builder* of one of his *Majeſty's yards*, I am informed, that it is not uncommon for the timber of ſhips to be eat by the worm under the copper ſheathing, where the joints have not been carefully cloſed; ſo that in fact it is not ſo much its being a *poiſon*, as the means of their total *excluſion*, by a coating that they cannot penetrate, that prevents their deſtroying the wood: we may therefore, rather impute the want of ſucceſs in the year 1734, to their not being ſkilful to cloſe the joints of the copper plates ſufficiently compact.

† It was in this ſtorm that Admiral BALCHEN was loſt in the *Victory*.

‡ After the appointment of Mr. JESSOP, and in conſequence of the numbers of uprights torn away in the ſtorm of 1744, which enabled him to ſee further into the conſtruction of the ſolid than had been known before; he made a ſtill more accurate *Evolute*, and alſo a model of the Lighthouſe, and it is principally from the meaſures of this Evolute, that I have compiled the preſent draught, Plate N° 6.

§ The ſignal, when any thing was wanted by the Lightkeepers, was to hoiſt a large flag upon a flag-ſtaff from the balcony rails (as has been obſerved in the references to the Plates N° 5 and 6) on the leeward ſide, ſo as to be fully extended by the wind, clear of the building; which could eaſily be ſeen in moderate weather from the heights about *Ram-Head:* and that it might never be hung out in vain, it was a rule, that the perſon who carried the firſt notice to the agent at Plymouth, received from him half a guinea; the agent immediately on this proceeded to hire and ſend out a boat, to land, if poſſible, and at leaſt to know what was wanted.

to get the dead body diſpoſed of, and thrown into the ſea; and it was ſome time after that, before the rooms could be got freed from the noiſome ſtench that was left. This induced the proprietors to employ a *third* man; ſo that in caſe of a future accident of the ſame nature, or the ſickneſs of either, there might be conſtantly one to ſupply the place.

This regulation alſo afforded a ſeaſonable relief to the Lightkeepers; for ever ſince there were three, it has been an eſtabliſhed rule, that in the ſummer, in their turns, they are permitted each to go on ſhore, and ſpend a month among their friends and acquaintance.

58. WHETHER the abovementioned two men, of which one died, were the two to which the following account that I found very current in the country, referred; or it was a couple preceding them, is now uncertain: but a boat landing there with viſitants of curioſity (as not unfrequently happens in the ſummer ſeaſon) after examining the place and ſtructure; they obſerved to one of the men, how very comfortably they might there live in a ſtate of retirement. "Yes," ſays the man, "very *comfortably*, if we could have the uſe of our *tongues*; but it is now a full month ſince my partner and I have ſpoke to each other." The appointment of *three* has moſt likely put a ſtop to this piece of unſeaſonable taciturnity; for though we have ſeen it is poſſible to find two, yet it is ſcarcely probable there ſhould be found *three together* of this mind *.

Being now upon the chapter of anecdotes, I will proceed to give one, that ſhews how very different the ideas of mankind are concerning the nature of *confinement*. It happened in ſome one of the laſt years of the continuance of the late building; and I was told the ſtory by the very *ſkipper* who bore a part in the converſation. Says the ſkipper to a ſhoemaker in his boat, who he was carrying out to be a lightkeeper; How happens it, friend *Jacob*, that you ſhould chuſe to go out to be a lightkeeper, when you can on ſhore, as I am told, earn your half crown and three ſhillings a day in making leathern hoſe †; whereas the lightkeeper's ſalary is but £. 25 a year, which is ſcarce ten ſhillings a week? Says the ſhoemaker, I go to be a lightkeeper becauſe I don't like *confinement!* After this anſwer had produced its ſhare of merriment; he at laſt explained himſelf, by ſaying, that he did not like to be *confined to work*.

59. WE now come to the laſt awful ſcene, containing the fatal *cataſtrophe* of this celebrated building.

On the 22d of Auguſt 1755 the workmen returned on ſhore, having finiſhed all neceſſary repairs of that ſeaſon: between which time and the 2d of December following, the attending boat had been off ſeveral times to the Edyſtone, and particularly on the 1ſt of December, and had landed ſome ſtores, when the lightkeepers made no manner of complaint; and ſaid all was right, except that one or two of the bricks in the kitchen fire-place, had been looſened by a late ſtorm ‡.

60. WHAT in reality might occaſion the building's firſt catching fire, it has never been poſſible fully to inveſtigate; but from the moſt diſtinct account, it appears to have commenced in the very top of the lantern, that is, in the *cupola*.

If I might hazard conjectures, I would ſuppoſe, that the whole building being of wood, and the heat of the candles in the lantern conſiderable §, and this repeated every night for between 40 and 50

* It is very poſſible I might have paſſed over this anecdote in ſilence, had it not been alluded to in one of the ſpeeches of Lord NORTH, in the time of the late war, where he gives this as an inſtance how the *public ſervice* is liable to be obſtructed by *private diſſentions*: however juſt this remark, yet as it may be a ſatisfaction to the maritime part of the public to know it; I beg leave to ſay, I never heard that *this line* of the *public* ſervice was ever intermitted or obſtructed by this or any diſſentions among the parties themſelves.

† Leathern pipes ſo called.

‡ This is another proof of the violent agitation this building was put into by ſtorms and hard gales of wind.

§ *Viz.* 24 candles burning at once, five whereof weighed two pounds, and it was uſual to go into the lantern to ſnuff them every half hour.

years

years together, we may well ſuppoſe the wood above them, and particularly the lining of thin boards that ſupported the uppermoſt cover of ſheet lead, to be brought into a perfect ſtate of dryneſs and inflammability; and this of courſe being covered with a thick cruſt of ſoot, collected by receiving the ſmoke of the candles, the whole together would become in reality a maſs of *tinder* and *matches*. Now if we can ſuppoſe it poſſible for a ſingle ſpark to fly from one of the candles, and lodge itſelf in this maſs of combuſtible matter, the conſequence is obvious: or, if we ſuppoſe, that in length of time, the copper funnel in paſſing the cupola, had been corroded by the ſalts of the ſea falling into it in ſtorms, and alſo by the pit-coal ſoot from the kitchen fire, ſo as to open a hole into the upper part in the cupola, by which, a ſpark might iſſue from the fire below, the conſequence would be the ſame *. But whether either of theſe may be eſteemed a probable account of the origin of the fire, or not, it is certain, that when the lightkeeper then upon the watch (about two o'clock in the morning of the 2d of December) went into the lantern as uſual to ſnuff the candles, he found the whole in a ſmoke; and upon opening the door of the lantern into the balcony, a flame inſtantly burſt from the inſide of the cupola: he immediately endeavoured to alarm his companions; but they being in bed and aſleep, were not ſo ready in coming to his aſſiſtance as the occaſion required.——As there were always ſome leathern buckets kept in the houſe, and a tub of water in the lantern; he attempted as ſpeedily as poſſible to extinguiſh the fire in the cupola, by throwing water from the balcony with a leather bucket, upon the outſide cover of lead: by this time, his comrades approaching, he encouraged them to fetch up water with the leather buckets from the ſea; but as the height would be at a medium full 70 feet, this, added to the natural conſternation that muſt attend ſuch a ſudden and totally unexpected event, would occaſion this buſineſs of bringing up water, at the beſt to go on but ſlowly. Meanwhile, the flames gathering ſtrength every moment, and the poor man, though making uſe of every exertion, having the water to throw full four yards higher than his own head, to be of any ſervice; we muſt by no means be ſurpriſed, that under all theſe difficulties, the fire, inſtead of being ſoon extinguiſhed, would increaſe; and what put a ſudden ſtop to further exertions, was the following moſt remarkable circumſtance.

As he was looking upward with the utmoſt attention, to ſee the direction and ſucceſs of the water thrown; on which occaſion, as *phyſiognomiſts* tell us, the mouth is naturally a little open; a quantity of lead, diſſolved by the heat of the flames, ſuddenly ruſhed like a torrent from the roof, and fell, not only upon the man's head, face and ſhoulders, but over his cloaths; and a part of it made its way through his ſhirt collar, and very much burnt his neck and ſhoulders: from this moment he had a violent internal ſenſation, and imagined that a quantity of this lead had paſſed his throat, and got into his body. Under this violence of pain and anxiety, as every attempt had proved ineffectual, and the rage of the flames was increaſing, it is not to be wondered that the terror and diſmay of the three men increaſed in proportion; ſo that they all found themſelves intimidated, and glad to make their retreat from that immediate ſcene of horror, into one of the rooms below: where they would find themſelves precluded from doing *any thing*; for had they thrown down ever ſo much water there, it could not have extinguiſhed what was burning above them; nor indeed, produce any other effect, than that of running down into the rooms below; and from thence finally through the ſtaircaſe, back again into the ſea: they ſeem therefore to have had no other reſource or means of retreat, than that of retiring downwards from room to room, as the fire advanced over their heads.

61. HOW ſoon the fire was ſeen from the ſhore, is not very certain; but early in the morning it was perceived by ſome of the *Cawſand* fiſhermen †, and intelligence thereof given to Mr. EDWARDS

* This ſuppoſition is not without grounds, as the lightkeepers, after the accident, declared, that the fire broke out from the chimney or funnel into the cupola; but were not believed *then*, as the whole of it that paſſed through the lantern was of *copper*.

† *Cawſand Bay* is a capacious bay within the confines of Plymouth Sound; it lies juſt within the Sound, on the weſt ſide; the ſouthermoſt point of this bay is Point *Penlee*, which is alſo the extreme point of Plymouth Sound on the weſt ſide; and the two fiſhing towns of *Kingſton* and *Cawſand* are ſituated at the bottom of the bay. See the Map, N° 2.

of

of *Rame* in that neighbourhood, a gentleman of ſome fortune, and more humanity. This prompted him immediately to ſend out a fiſhing-boat and men, to the relief of the people he ſuppoſed in diſtreſs upon the Edyſtone *.

The boat and men got thither about ten o'clock, after the fire had been burning full eight hours; and in this time, the three lightkeepers were not only driven from all the rooms, and the ſtair-caſe, but to avoid the falling of the timber, and red-hot bolts, &c. upon them, they were found ſitting in the hole or cave on the Eaſt ſide of the rock (See Plate N° 6 Letter q, alſo Plate N° 14 Letter X) under the iron ladder, almoſt in a ſtate of ſtupefaction; it being then low water.

62. AT this time the wind was eaſtwardly, and did not blow very freſh; but juſt hard enough to make a landing upon the rock, at the proper landing-place (which is on the Eaſt ſide) quite impracticable, or attended with the utmoſt hazard. It therefore became a difficulty, how the men were to be taken off; for the ground ſwell upon the Weſt ſide produced ſo great a ſurf upon the ſloping ſurface, that no boat could attempt to land there. They however fell upon the following expedient: having a ſmall boat with them, they moored their principal boat by a *grapling* to the weſtward; but as near the rock as they durſt; and then launching their ſmall boat, they rowed it towards the rock, veering out a rope, which they had faſtened to the large boat, till they got near enough to throw a coil of ſmall rope upon the rock; which having been laid hold of by the men, they one by one faſtened it round their waiſts, and jumping into the ſea, they were towed into the ſmall boat; and from thence delivered into the large one: and as they found that it was out of their power to do any further ſervice, this boat haſtened to Plymouth to get the men relieved. No ſooner however were they ſet on ſhore, than one of them made off, and has never ſince been heard of: which would on the firſt bluſh induce one to ſuppoſe, there was ſomething culpable in this man; and if it had been a houſe on ſhore one would have been tempted to ſuſpect he had been guilty of ſome foul play: but the circumſtance of its being a Lighthouſe, ſituated ſo as to afford no retreat in the power of its inhabitants, ſeems to preclude the poſſibility of its being done wilfully; as he muſt know, he muſt periſh, or be in extreme danger of ſo doing at leaſt, along with the reſt. I would therefore rather impute his ſudden flight, to that kind of *panic*, which ſometimes, on important occaſions, ſeizes weak minds; making them act without reaſon, and in ſo doing commit actions the very reverſe in tendency of what they mean them to have; and of which they have afterwards occaſion to repent: but the man already deſcribed to have ſuffered ſo much by the melted lead, was ſent to his own houſe at *Stonehouſe*, a village near the place where they landed.

63. IT was not long after the alarm was made at Cawſand, that the dreadful news reached Plymouth; and as from the compoſition of the ſtructure, it was thought that a conſiderable part of it might be ſaved, at leaſt of the foundation, endeavours were not wanting for that purpoſe; for Mr. Alderman TOLCHER, the agent and collector of the duties, who was a perfect enthuſiaſt for the welfare of the Lighthouſe; and his ſon Mr. JOSEPH TOLCHER, immediately went out to ſea; both gentlemen were ever, but then more than ever, indefatigable in their endeavours for its preſervation. When they came there, alas! what could they do? There was no landing, except at the imminent hazard of their lives; and if landed, they could not do any thing. They could therefore only have the ſupreme mortification to behold, that after the rooms and all the upper works were totally deſtroyed, the fire was rapidly communicating itſelf into the ſolid; and there being many beds of ſolid timber above all the ſtone, their connexion with thoſe below, by means of the maſt and ſtairs in the well-hole, and by the upright timbers on the outſide, would not ſuffer a doubt to remain, that after ſuch a maſs of fire was generated above, it would gradually communicate itſelf to the beds of timber interpoſed between thoſe of Moor-ſtone, and by that means conſume the whole.

* I am informed by my eſteemed friend Dr. MUDGE of *Plymouth*, that the philanthropy of this worthy gentleman on this occaſion, coſt him his life; for his exertions gave him ſo violent a cold as to bring on complaints of which he ſhortly after died.

64. THE late worthy ADMIRAL WEST, who then lay with a fleet in Plymouth Sound, on hearing of the accident, immediately ſent out a ſloop properly manned, with a boat and an engine therein, which alſo carried out Mr. JESSOP the ſurveyor; this veſſel alſo arrived early in the day on which the fire happened. In endeavouring to make a landing of the engine, on the Weſt ſide, it being then about low water, the boat, men and engine were at once toſſed upon the rock by a wave, which on its retreat left them thereon; and before the engine was got out of the boat, another wave came, ſet them afloat, and ſwept them back again to their former ſituation: *Britiſh Tars* are not diſmayed with ſmall matters; however, *this* accident ſufficiently taught them to be thankful for an eſcape with their lives; and to make no further attempt to land: yet they notwithſtanding tried to play the engine from the boat; but the agitation of the ſea near the rock was ſuch, that they very ſoon broke the engine pipe; and ſo ended this well meant expedition, in a total diſappointment.

65. THE only hopes that then remained, were from a great addition to the wind, which then blew; or a ſhift of wind to the S. W. quarter: for, the rocks being nearly perpendicular on the Eaſt ſide; and the ſeas being in ſome meaſure broken by the *South Reef* ſtretching on the Eaſt ſide of the *Houſe Reef*, (See Plate N° 3.) it is only in hard gales of wind that the ſea breaks in quantity, and bodily over the houſe reef from the Eaſt towards the Weſt; whereas, the wind if only freſh at S. W. increaſes the ground ſwell, which is almoſt conſtant (more or leſs) from that quarter, to a degree that would infallibly have put out the fire: but if we are believers in *Fate*, we muſt ſuppoſe that this building had been deſtined to a total deſtruction: for the wind continued almoſt invariably at the ſame quarter, and with the ſame degree of ſtrength; ſo that there was conſtantly ſea enough to prevent all attempts to land, and yet not enough to cauſe the ſeas to break ſo high, and in ſuch quantity as to put out the fire.

In the ſucceeding days, it was obſerved that the interpoſed beds of timber were ſufficient to heat the Moor-ſtone beds red hot; and that the whole maſs became one great body of red hot matter. Nor was it till the 7th of the ſame month, that the joint action of the wind, the fire and the ſeas totally completed the cataſtrophe ſo fatally begun; and then left no other evidence of the deſtruction they had made, than that the greateſt number of the iron cramps and branches were left ſtanding upright upon the rock.

66. WE will now return to the poor unfortunate man, who had received ſo peculiar an injury by the melted lead. His name was HENRY HALL of *Stonehouſe* near Plymouth, and though aged 94 years, being of a good conſtitution, he was remarkably active conſidering his time of life: he had invariably told the ſurgeon who attended him (Mr. SPRY, now Dr. SPRY of Plymouth, who conſtantly adminiſtered the proper remedies to ſuch burns and hurts as could be perceived) that if he would do any thing effectual to his recovery, he muſt relieve his ſtomach from the lead, which he was ſure was within him: and this he not only told Dr. SPRY, but thoſe about him, though in a very hoarſe voice; and he alſo ſaid the ſame thing to Mr. JESSOP, who went to ſee him ſeveral times during his illneſs, and who gave me this information. The reality of the aſſertion ſeemed however then incredible to Dr. SPRY, who could ſcarcely ſuppoſe it poſſible, that any human being could exiſt, after receiving melted lead into the ſtomach; much leſs that he ſhould afterwards be able to bear towing through the ſea from the rock; and alſo the fatigue and inconvenience from the length of time he was in getting on ſhore, before any remedies could be applied. The man did not ſhew any ſymptoms however of being either much worſe, or of amendment, till the ſixth day after the accident, when he was thought to be better: he conſtantly took his medicines, and ſwallowed many things both liquid and ſolid till the tenth or eleventh day; after which he ſuddenly grew worſe; and the twelfth day being ſeized with cold ſweats and ſpaſms, he ſoon afterwards expired.

Mr. JESSOP was deſired by Dr. SPRY to attend the opening of the body; but being averſe to ſights of that kind, he excuſed himſelf from ſeeing the operation; as did alſo the daughter of the deceaſed, and another woman who was in the houſe. On opening the ſtomach Dr. SPRY found therein, a ſolid piece of lead of a flat oval form, which weighed *Seven Ounces* and five drachms, and this he immediately ſhewed

to

to the two women, and afterwards to Mr. JESSOP. I have alſo ſeen the piece of lead ſince in the hands of Mr. TOLCHER, and it appeared to me, as if a part of the coat of the ſtomach firmly adhered to the convex ſide thereof.

67. BY a letter of the 19th December, Dr. SPRY tranſmitted an account of this very ſingular caſe to the *Royal Society*, incloſing the exact weight and figure of the lead; but that learned body thinking the circumſtance very unlikely and extraordinary, and doubting the truth of it, the reading of the paper was deferred till a further elucidation was received.

As Dr. SPRY had on this occaſion been deprived of the benefit of eye-witneſſes; and ſuppoſing his character called upon, not only as a profeſſional man, but as a man of veracity; he endeavoured to ſupport himſelf by experiments of the ſame kind upon different animals.——He therefore tried what would happen by pouring melted lead down the throats of dogs and fowls, to the amount of, from ſix drachms to ſix ounces; and found that thoſe animals ſurvived the operation, till they were killed to extract the lead: and Dr. SPRY ſays, he kept one dog with lead in his ſtomach, with intent to try how long he might ſurvive.

The account of theſe experiments is contained in a letter of the 30th January 1756, from Dr. SPRY, addreſſed to LORD MACCLESFIELD, then *Preſident* of the Royal Society; and it was further corroborated by a letter from the late Dr. HUXHAM of Plymouth, F. R. S. to the late Sir WILLIAM WATSON, F. R. S. who ſpeaks not only to the ingenuity and veracity of Dr. SPRY, but of his being himſelf eye-witneſs to the extraction of a lump of lead of near three ounces weight, from the crop of a cock, that previous to being killed, though he ſeemed dull, yet readily pecked and ſwallowed ſeveral barley-corns that were thrown to him *.

Though the authenticity of this wonderful (and till this inſtance unheard of) capacity of animal bodies was thus inveſtigated †; yet Dr. SPRY was ſtill ſo unfortunate as to fall under a cenſure of a different kind; that of cruelty towards the animals, in trying the experiments mentioned.

For my own part I cannot but think that Dr. SPRY was ſomewhat hardly uſed: he attempted no experiments upon other animals, till he found his account diſbelieved by the moſt eminent of his profeſſion; his character therefore and future proſpects in life were endangered, he being then a young gentleman of ſome expectations. What therefore was the compariſon between the lives of a few dogs and poultry, to the loſs of character of a man bred to a profeſſion, upon his ſucceſs in which, as depending upon the good opinion of others, muſt depend likewiſe that benefit and utility which he might be of to his fellow-ſubjects? Such however was Dr. SPRY's lot, that in eſtabliſhing his abilities in his profeſſion, he was then by ſome ſtigmatized with the imputation of inhumanity.

68. IT has been thought by many, that if the poor lightkeepers, when in the midſt of their diſtreſs, had been poſſeſſed of reflection enough to have thrown out their combuſtible ſtores, ſuch as cheſts of *Candles*, *Coals*, &c. there might have been a probability of ſaving the whole, or ſome part of the *ſolid* of the Lighthouſe; in which caſe, the repair would have been ready and eaſy; and the following ſummer might have been ſufficient for its reinſtatement: but in my own opinion, the doing of this could not have retarded the progreſs of the fire a ſingle hour; for, in the three upper rooms there was little more to burn than in the ſtore-room, had it been emptied of ſtores; and the ſame communication by the uprights,

* Thoſe that are further curious on this ſubject, will find a full account thereof in the 49th vol. of the *Philoſophical Tranſactions* page 477, wherein Dr. SPRY fully deſcribes the complaints and method of treatment of his patient; and in the ſucceeding articles are other particulars above referred to.

† Though there is at preſent no doubt of the fact of the lead being taken out of the man's ſtomach after he had ſurvived it 12 days; yet theſe experiments by no means prove, that it would not be inſtant death to the human ſpecies, in by far the *greateſt number* of caſes.

would

would have taken place here, as above; and the ſtore-room floor, being itſelf, and every thing underneath it, of wood, for a depth or thickneſs of between ſix and ſeven feet; and this open in the center by a ſquare of above ſix feet, in which were included the ſtairs and the maſt, there could be no want of communication for the fire, from the rooms to the ſolid, even excluſive of all the ſtores: nor can I conceive any thing within the reach of human art could have ſaved the building, even if the rock had been acceſſible; unleſs there had been time enough for ſhipwrights or carpenters to have been ſent out with proper tools, before the fire had got ſo low as the ſtore-room: then indeed it would have been very practicable to have cut the uprights quite round the building, where they were only a ſingle thickneſs, as was the caſe above the ſtore-room floor; and by ſupporting the *Saw-gate* with wedges, the whole of the ſuperſtructure, together with the maſt, might have been expeditiouſly ſevered from the ſolid: but even after this, under the circumſtances beforementioned, it would have been very problematical, whether a battery of chain ſhot from a ſhip of war, carrying heavy metal, could have ſo ſpeedily and effectually diſperſed the ſuperſtructure ſo ſevered, as to have prevented its fragments from ſetting fire to the ſolid below: and to ſuch a maſs of combuſtibles, had the ſolid caught fire, a ſingle fire-engine, or even two, which would be rather more than could have been worked upon the rock, with any degree of convenience, would have proved very inadequate.

Nothing therefore, as it ſeems, but a ſtorm, or hard gale of wind at South-weſt, as already hinted, could have effectually put out the fire, ſo as to have ſaved any material part of the building, which, after a duration of forty-nine years from its commencement, was doomed to inevitable deſtruction, by an element, not ſo much as thought of as an *Enemy*; or guarded againſt, as ſuch, in its erection.

BOOK II.

An Account of preparatory matters towards building the preſent Lighthouſe *upon the* EDYSTONE ROCK *with* STONE.

CHAP. I.

Containing the Proceedings from the deſtruction of Mr. RUDYERD's *Lighthouſe in December* 1755, *to* Mr. SMEATON's *departure from* LONDON *to* PLYMOUTH *in March* 1756.

69. THE Lighthouſe happily effected by Mr. RUDYERD, having been totally conſumed by fire in December 1755, as before related; and the Proprietors, having the remainder of a term therein of above half a century, they immediately applied themſelves in the moſt ſtrenuous manner towards the erecting of another Lighthouſe in the place of that which had been, both for themſelves and the public, ſo unfortunately deſtroyed. In this however there aroſe ſome difficulties; for a ſpace of 30 years having elapſed, ſince the purchaſes of ſhares by the three families which I have mentioned, § 53, in this interval a number of changes (as might reaſonably be expected) had happened in the property. Some ſhares of the Lighthouſe having been deviſed by will to be divided amongſt children, and ſettlements on marriage having taken place with reſpect to other ſhares thereof; the claimants therefore were now become numerous. The whole intereſt of the third perſon mentioned, Mr. CHEETHAM, being three ſhares, was however at this time veſted in a Mrs. HOFSLEGGER, they having been ſettled upon her in marriage; and on this account, the principal impediment occurred; for without the expenditure of a conſiderable ſum of money, ſuch as it might be ſuppoſed three-eighths of the erection would coſt, the whole of her ſhares could not be valued at any thing; no duties being payable while no light was exhibited*: and as her eſtate in the Lighthouſe was only for life, it was not to be expected that ſhe ſhould advance a ſum of money, from the expenditure of which the greateſt benefit might probably devolve upon her ſucceſſors. In conſequence of this circumſtance, an early application to *Parliament* took place, and an act was obtained enabling Mrs. HOFSLEGGER to ſell ſo much of her property and intereſt in the Lighthouſe, as would pay for that ſhare of the building ſhe was to retain.

On the other hand it may be reckoned among the fortunate circumſtances attending this *Cataſtrophe*, that the three-eighths purchaſed by the WESTON's, not only remained in that family, but continued ſo far united, that, though ſeparately taken they were in different branches, yet the executive part for the whole of theſe ſhares was in one perſon: and as at this time the claimants under the NOYES's family were more than a dozen in number, it ſtill more fortunately happened, that ROBERT WESTON, Eſq; from his having for years paſt taken a moſt diſcreet part, reſpecting the management of this property, and having ſo conſiderable a ſhare in his own perſon, had the utmoſt truſt and confidence repoſed in him by the whole body of the proprietors: but it may be reckoned among the moſt fortunate of all the circumſtances for the future undertaking, that this gentleman was not more remarkable for his ſtrict integrity, than for his diſcernment and univerſal *Philanthropy*.

* An early piece of juſtice, which indeed has always marked the Proprietors, appeared by their advertiſement in the *Gazette*, and other newſpapers, in the firſt fortnight after the accident happened, importing that the duties had ceaſed till a freſh exhibition of a light; and that the money which had been, or ſhould be paid by ſhips, after the demolition, would be returned by the agents who received it.

He conſidered that this was not a work proper to be advertiſed; or put into the hands of a general undertaker in the building way; and that it would not be better for the ornaments to be derived from the *five Orders*; that it was a work of a very peculiar kind; and that to reinſtate it, would not ſo much require a perſon who had merely been bred, or had even rendered himſelf eminent, in this, or that given profeſſion; but rather one who from natural genius had a turn for contrivance in the mechanical branches of ſcience; and that ſuch a one would be the moſt likely perſon to take into conſideration the peculiarities, the advantages, and diſadvantages of the ſituation, as well as other circumſtances: in ſhort, that it required a perſon who would not ſtand in need of being led by the actual execution of a ſimilar performance; but who ſolely from the nature of the thing, would be likely to find out the proper methods of executing a building of the like kind with that, which had approved itſelf upon an experience of near 50 years; ſuch a perſon being the moſt likely to diſcern how far the late building was defective, how far theſe defects were capable of a remedy; and what improvements could be made upon the former conſtruction.

60. IN this view Mr. WESTON laid aſide thoſe prejudices of the ignorant, who conſider the *Royal Society* as a body of *theoretic Men* only, having nothing amongſt them practical, or applicable to the real buſineſs of human life; he well knew that though in a multitude there might be many of that denomination; yet that there were alſo many real artiſts in this body: and that ſince its inſtitution by *King* CHARLES *the Second*, the moſt important inventions, applicable to the greateſt purpoſes of human life, had originally ſprung from the joint labours of ingenious men, either actually members, or connected by correſpondence with thoſe who were ſo: and this without a view to any particular emolument or reward.

Under theſe circumſtances, Mr. WESTON applied to the late Earl of MACCLESFIELD, the then *Preſident of the Royal Society*; a nobleman ſcarce known to him, but by public character. On communicating the object of his viſit, Lord MACCLESFIELD told him, that there was one of their Body whom he could venture to recommend to the buſineſs; yet that the moſt material part of what he knew of him was, his having within the compaſs of the laſt ſeven years, recommended himſelf to the ſociety by the communication of ſeveral mechanical inventions and improvements; and though he had at firſt made it his buſineſs to execute things in the inſtrument way (without having ever been bred to the trade) yet on account of the merit of his performances, he had been choſen a member of the ſociety*: and that for about three years paſt, having found the buſineſs of a *Philoſophical Inſtrument Maker* not likely to afford an adequate recompence; he had wholly applied himſelf to ſuch branches of mechanics, as he (Mr. WESTON) appeared to want; that he was then ſomewhere in *Scotland*, or in the north of *England*, doing buſineſs in that line: that what he had to ſay further of him was, his never having known him undertake any thing, but what he completed to the ſatisfaction of thoſe who employed him; and that Mr. WESTON might rely upon it, when the buſineſs was ſtated to him, he would not undertake it, unleſs he clearly ſaw himſelf capable of performing it.

This kind of character which the noble Earl was pleaſed to honour me with, proved fully ſatisfactory to Mr. WESTON, and as his Lordſhip did not know how to direct to me, he learnt from him, that as I was well acquainted with Mr. B. WILSON an eminent painter in *Great Queen-ſtreet*, he would probably get a direction to me from that gentleman.

Upon this, he immediately applied to Mr. WILSON, who undertook to write to me (being then in *Northumberland)* which he did very laconically, ſignifying that I was made choice of as a proper perſon to rebuild the *Edyſtone Lighthouſe:* this was early in the month of January 1756.——I had at that time, but barely heard that the Edyſtone Lighthouſe was deſtroyed by *Fire*; and having ſeen a popular print of it, I underſtood that it was a building very critically placed out at ſea, upon a ſingle rock: but as I had no doubt that its foundation part at leaſt, was built with *Stone*, though its upper works had the appearance of timber, I could not readily conceive how it could be *totally* deſtroyed. I concluded therefore, that the object was to *repair* or reſtore the *Upper Works:* and therefore I received the call without joy,

* Mr. SMEATON was choſen Fellow of the *Royal Society* 15 March 1753.

or

or indeed much emotion of any kind; concluding, as moſt public works of conſequence were undertaken upon advertiſements, the meaning was, that I ſhould return to London to give in my propoſals along with other candidates.

I therefore returned my friend for anſwer, that I ſuppoſed it was meant I ſhould go back to town in order to form a ſcheme, which if it had the good luck to be thought preferable to that of others, I was to be employed in the *Repair* of the building: if this was the caſe, I had engagements and proſpects before me, that I could not leave upon any uncertainty; but that if I was abſolutely choſen to this buſineſs, I ſhould think it ſo great an honour done me, that in one month I would diveſt myſelf of all other engagements, and attend the gentlemen in town. To this I received an anſwer from my friend, even more laconic than before. That it was a *total* demolition, and that as NATHAN ſaid unto DAVID "*Thou art the Man.*"

61. HAVING acquitted myſelf of the buſineſs in which I had been engaged in the North, I arrived in London the 23d February 1756; and the next day, agreeable to a meſſage I had received for that purpoſe, waited on ROBERT WESTON, Eſq; till then totally unknown to me. The hours ſpent in this interview, were taken up in my attention to a relation of the nature of the ſtructure of the former Lighthouſes of Mr. WINSTANLEY and Mr. RUDYERD; and in examining ſeveral plans, models and drawings in Mr. WESTON's poſſeſſion, that referred thereto.——I was till then, I may ſay, almoſt a total ſtranger to thoſe ſtructures and their ſituation (which indeed by the deſcription now given of them appeared very formidable) as I never happened to have been in thoſe parts; and a mechanical deſcription of them never fell in my way: but from the information now given me, I thought a little time and ſtudy would make me ſufficiently maſter of the ſubject, to enable me to give my opinion in general, what plan it would be beſt to purſue.

It is true I found myſelf at firſt under ſome little reſtraint, from that freedom I would ever wiſh to exert; by diſcovering in the courſe of this day's converſation, a ſtrong propenſity in this gentleman for purſuing the former deſign; I mean that of Mr. RUDYERD: but when what has been already ſaid upon that ſtructure is conſidered, I muſt own that Mr. WESTON's attachment was very reaſonably founded. There were other circumſtances too, which might have been a ſtill greater clog and impediment to the ſcope of my thoughts, had the gentlemen Proprietors ſuffered themſelves to have been biaſſed thereby; I mean a *partial View* to their own *immediate Intereſt*. But I was ſoon releaſed from every ſuppoſition of this kind; for on putting the query, that if any improvement could be made in the ſtability or durability of the ſtructure, whether the Proprietors would wiſh to adopt it; though it ſhould incur a greater expence than a mere re-erection of the laſt building? He replied, with an emphaſis which gave me no doubt of his ſincerity; that if there was a poſſibility of rebuilding the Lighthouſe in any better or more durable manner than it had been, though almoſt half of the original leaſe from the Corporation of TRINITY-HOUSE was then expired, yet the matter being now in their hands, they ſhould think themſelves bound, for the ſake of poſterity, to do every thing that lay in their power to render the new building not only effectual for their own time, but as *permanent* as poſſible.——And, on coming away, Mr. WESTON ſaid, I was not to think myſelf at all indebted to him, or any of the Proprietors for the undertaking I was likely to be engaged in; ſince if either he or they could have heard of any perſon more capable of deſigning and executing ſuch a work, he ſhould not have ſeen me at his houſe that day: which valediction, though in the groſs ſenſe, it might be ſaid to contain little of *Obligation*; yet as it at once ſhewed me that I was likely to be received with that degree of truſt and confidence which is ſo eſſential to the ſucceſs of an arduous undertaking; it thereby became a pleaſing earneſt of that diſpoſition in the Proprietors, which muſt ever be ſatisfactory to an artiſt; that of wiſhing to have his work, whatever it might be, performed in the *beſt* manner; and therefore could not in this ſenſe, fail to be more highly agreeable than any other kind of compliment.

62. THE models and drawings having been ſent to me, I endeavoured by a full conſideration of them, to inveſtigate the particular plan of the reſpective architects; but could not trace out that of either

either of them to my perfect ſatisfaction. They afforded me juſt ſo much light as to enable me to diſcern the want of more information: and I found upon further enquiry, that neither the models, drawings or prints were coeval with the ſtructures they were intended to repreſent, except the print of Mr. WINSTANLEY's Lighthouſe publiſhed by himſelf in the year 1699, before referred to; for as to the models, &c. relative to Mr. RUDYERD's, ſave a few original drawings, that ſhewed how ſome of the courſes of ſtone were laid, as I have already mentioned, they were all of a late date, chiefly ſince the year 1734; and rather uſeful for *repairing* than *rebuilding* the houſe; exhibiting no more of the inſide work, than what was diſcovered by the openings that were made at the time ſuch repairs were carried on; ſo that at beſt thoſe could afford but very defective information, as to the particular original deſign; though they had been neceſſary for conducting the repairs of that building.

From ſimilar obſervations, the models had alſo been framed; but to render theſe more complete, to appearance, imagination was taken in to ſupply what never could have been obtained by real inſpection: for, as no models, draughts orſections, that had been made at the time the houſe was built (except as before mentioned) were handed down to poſterity; concluſions were drawn, from the things that were apparent, with reſpect to the inward ſtructure; ſo that when any part of the caſe, or outſide timbers that covered them, were taken off to be repaired, the models and drawings that were in conſequence made by ſuch kind of piecemeal diſcoveries, were in reality the beſt evidences I have ſeen of the nature of the ſtructure, and therefore could not give me a full information.

This being the caſe, after all I could glean from the drawings and models, as well as every inſight into the nature of the work, that Mr. WESTON from ſeveral interviews could give me; I was naturally led to conſider what could be done by an erection *entirely of Stone*; as along with greater natural permanency of materials than wood, it would not be liable to deſtruction by fire; againſt which no abſolute defence (as it appeared to me) could be applied, if rebuilt with timber. In fact, on firſt hearing of the late Lighthouſe having been deſtroyed, I had conceived that the interiour part of the foundation, and indeed for a conſiderable height, muſt have been a ſolid body of ſtone, though the outſide might have been covered with wood, (as it appeared from the only figure of it I had ever ſeen); and which I ſuppoſed might have been thought neceſſary by the builder, to prevent that waſh of the joints, that a very expoſed ſituation might ſubject it to, in caſe the cement was not of the very beſt kind poſſible for water-works: and ſuch having been my thoughts, my imagination was in conſequence carried to ſuppoſe how ſuch a building might have been put together in the moſt effectual manner. Coming therefore to town with theſe ideas, and finding how very ſhort the beſt account of the real ſtructure fell of anſwering my conceptions; I was encouraged, from the declaration of the only Proprietor I had ſeen, as being the ſenſe of the reſt, as well as from the apparent utility to the public, and poſſibly in the end to the Proprietors themſelves, to turn my thoughts towards the practicability of a ſtone building: which propoſition appearing in a light more favourable, in proportion as I thought more upon it; in a very few days I became ſo ſatisfied, that I deſired an interview with the body of Proprietors upon a *primary* and *leading Queſtion*.

63. AT this meeting I ſtated the great advantages that would ariſe from a *Stone Building*, which indeed were quite obvious to all; but the difficulty was, how ſuch a building could be carried into execution; for though the Proprietors unanimouſly declared, that they would make no objection to any reaſonable expence in procuring that durability and ſafety, which would be the evident reſult, if a building with ſtone could be effectually eſtabliſhed; yet they very properly obſerved, that as the late building had fully anſwered the end, for almoſt *half a Century*; were any thing to fail, in caſe they altered the mode of the ſtructure, for *any Reaſon whatever*, however laudable, they ſhould be condemned by the public, for having attempted an alteration, though even for the ſervice of the public; and the loſs muſt fall upon themſelves as individuals, if, on any account whatever, they ſhould not ſucceed.——They likewiſe obſerved, that it had been generally thought by the beſt judges, that the ſafety and continuance of the late building, had in a great meaſure depended on the claſticity of the materials of which it was chiefly compoſed; which enabled it to give way to the violent ſhocks of the ſea, to which it was expoſed: and

that

that it was ſaid, by thoſe beſt acquainted with it, that its motion in violent ſtorms was ſo great, that frequently the *Trenchers* were thereby thrown from the ſhelves in the upper rooms: and that moſt undoubtedly, in theſe great agitations, *ſomething muſt give way*, which a ſtone building could not be expected to do, unleſs in the caſe of a total overthrow.

In anſwer to this I obſerved, that the great agitation which the late building was ſubject to, aroſe from its want of *Weight*, as well as want of *Strength*; that what I propoſed would be both much heavier and much ſtronger; and therefore if the building would not *give way to the Sea*, the *Sea muſt give way* to the building. I further obſerved, that I had not met them at ſo early a time to debate the mode of conſtruction of a ſtone building, or its properties; but to aſk them a ſimple queſtion: and that was, if I could convince their *own* underſtandings, that a building could be made with ſtone, not only ſo as to be more durable, but even more ſafe from every accident that could be foreſeen, and not likely to be attended with a charge enormouſly more large, whether they would *prefer ſuch a Building to the laſt*, which they had experienced could be conſumed by fire? becauſe, if not, it was to no purpoſe to ſpend time in aſcertaining the mode of doing a thing that muſt ultimately be rejected; but rather apply that time as early as poſſible, towards inveſtigating the beſt method of compoſing a ſtructure upon ſimilar principles with the former: I ſay *ſimilar Principles*, becauſe, as already ſhewn, there did not at that time appear to exiſt, any preciſe deſign of the former building: but that, if under the proviſo mentioned, they would prefer a ſtone building; the *onus probandi* ſhould be upon me; and if upon trial I could not ſatisfy *their* minds, as well as my *own*, of the practicability of my propoſition, I would then quietly give it up, and as ſtrenuouſly apply myſelf to what ſhould upon the whole appear the moſt *eligible:* and as it would not take up much time to produce ſomething in a *rough* way; as I underſtood it was too early in the ſeaſon for any operations upon the place, no very material time could be loſt. On this they unanimouſly agreed, that I ſhould make the attempt to convince them, and if convinced, they would act accordingly; unleſs controuled by ſome ſuperiour power.

64. IN reflecting upon the late ſtructure, with a wiſh to retain as much of it as poſſible, conſiſtent with the different nature of the material I had then in view, it appeared that the general form and ſize of the building, and diſtribution of the rooms of the houſe, were very proper and judicious. It appeared alſo moſt evidently, that had it not been for the moorſtone courſes, *inlaid* into the frame of the building, and acting therein like the ballaſt of a ſhip, it had long ago been overſet, notwithſtanding all the branches and iron-work contrived to retain it: and that in reality the violent agitation, *rocking* or vibration which the late building was deſcribed to be ſubject to, muſt have been owing to the narrowneſs of the baſe on which it reſted; and which, the quantity of vibration it had been conſtantly ſubject to, had rendered, in regard to its ſeat, in ſome degree rounding, like the *Rockers* of a cradle. It ſeemed therefore a primary point of improvement, to procure, if poſſible, an enlargement of the baſe, which from the models before me appeared to be practicable. It alſo ſeemed equally deſirable, not to increaſe the ſize of the preſent building in its *Waiſt*; by which I mean that part of the building between the top of the rock, and the top of the ſolid; and the Plate N° 6. (which has already been fully deſcribed) being ſuppoſed in my Reader's view, I muſt imagine him quite as well informed as I could be, at the time I am now deſcribing. If therefore I ſtill kept ſtrictly to the *conical* form, a neceſſary conſequence would be, that the diameter of every part being proportionably increaſed by an enlargement of the baſe, the action of the ſea upon the building would be greater in the ſame proportion; but as the ſtrength increaſes in proportion to the increaſed weight of the materials, the total abſolute ſtrength to reſiſt that action of the ſea, would be greater by a proportional enlargement of every part, but would require a greater quantity of materials: on the other hand, if we could enlarge the baſe, and at the ſame time rather diminiſh than increaſe the ſize of the waiſt and upper works; as great a ſtrength and ſtiffneſs would ariſe from a larger baſe, accompanied with a leſs reſiſtance to the acting power, though conſiſting of a *leſs Quantity of Materials*, as if a ſimilar conical figure had been preſerved.

65. ON this occaſion, the natural figure of the waiſt or bole of a large ſpreading *Oak*, preſented itſelf to my imagination. Let us for a moment conſider this tree: ſuppoſe at twelve or fifteen feet above its baſe, it branches out in every direction, and forms a large buſhy top, as we often obſerve. This top, when full of leaves, is ſubject to a very great impulſe from the agitation of violent winds; yet partly by its elaſticity, and partly by the natural ſtrength ariſing from its figure, it reſiſts them all, even for ages, till the gradual decay of the material diminiſhes the coherence of the parts, and they ſuffer piecemeal by the violence; but it is very rare that we hear of ſuch a tree being torn up by the roots. Let us now conſider its particular figure.——Connected with its roots, which lie hid below ground, it riſes from the ſurface thereof with a large ſwelling baſe, which at the height of one diameter is generally reduced by an elegant curve, concave to the eye, to a diameter leſs by at leaſt one-third, and ſometimes to half of its original baſe. From thence its taper diminiſhing more ſlow, its ſides by degrees come into a perpendicular, and for ſome height form a cylinder. After that a preparation of more circumference becomes neceſſary, for the ſtrong inſertion and eſtabliſhment of the principal boughs, which produces a ſwelling of its diameter.——Now we can hardly doubt but that every ſection of the tree is nearly of an equal ſtrength in proportion to what it has to reſiſt: and were we to lop off its principal boughs, and expoſe it in that ſtate to a rapid current of water, we ſhould find it as much capable of reſiſting the action of the heavier fluid, when diveſted of the greateſt part of its cloathing, as it was that of the lighter when all its ſpreading ornaments were expoſed to the fury of the wind: and hence we may derive an idea of what the proper ſhape of a column of the *greateſt Stability* ought to be, to reſiſt the action of external violence, when the *Quantity of Matter is given* whereof it is to be compoſed.

In Plate N° 13. Fig. 1. is a ſketch repreſenting the idea I formed of this ſubject. It is farther obſervable, in the inſertions of the boughs of trees into the bole, or of the branches into the boughs, (which is generally at an oblique angle) that thoſe inſertions are made by a ſwelling curve, of the ſame nature as that wherewith the tree riſes out of the ground; and that the greateſt *Rake* or *Sweep* of this curve, is that which fills up the obtuſe angle; while the acute angle is filled up with a much quicker curve, or ſweep of a leſs *Radius:* and Fig. 2. of the ſame plate repreſents my conception of this matter. ——In this view of the ſubject, I immediately rough-turned a piece of wood, with a ſmall degree of tapering above; and leaving matter enough below, I fitted it to the oblique ſurface of a block of wood, ſomewhat reſembling the ſloping ſurface of the Edyſtone Rock; and ſoon found, that by *reconciling Curves*, I could adapt every part of the baſe upon the rock to the regularly turned tapering body, and ſo as to make a figure not ungraceful; and at the ſame time carrying the idea of great firmneſs and ſolidity.

66. THE next thing was to conſider how the blocks of ſtone could be *bonded* to the rock, and to one another, in ſo firm a manner, as that, not only the whole together, but every individual piece, when connected with what preceded, ſhould be proof againſt the greateſt violence of the ſea: for, I plainly ſaw, from the relations I had got, that as every part of the work, even in the moſt favourable ſeaſons, was liable to be attacked by violent ſtorms; if any thing was left to the mercy of the ſea and good fortune, the building of the Edyſtone Lighthouſe with ſtone would be tantamount to the rolling of the ſtone of SISYPHUS.

On this head I conſidered the nature of *Cramping*; which, as generally performed, amounts to no more than a *Bond* upon the upper ſurface of a courſe of ſtone, without having any direct power to hold a ſtone down, in caſe of its being lifted upward by an action greater than its own weight; as might be expected frequently to happen at the Edyſtone, whenever the mortar of the ground bed it was ſet upon was waſhed out of the joint, when attacked by the ſea before it had time to harden; and though upright cramps to confine the ſtones down to the courſe below, might in ſome degree anſwer this end; yet as this muſt be done to each individual ſtone, the quantity of iron, and the great trouble and loſs of time that would neceſſarily attend this method, would in reality render it impracticable; for it appeared, that Mr. WINSTANLEY had found the fixing 12 great irons, and Mr. RUDYERD 35, attended with ſuch a conſumption of time (which aroſe in great meaſure from the difficulty of getting and keeping the holes dry,

dry, ſo as to admit of the pouring in of melted lead) that any method which required ſtill much more, in putting the work together upon the rock, would in conſequence inevitably, and to a very great degree, procraſtinate the completion of the building. It therefore ſeemed of the utmoſt conſequence to avoid this, even by any quantity of time and moderate expence, that might be neceſſary for its performance on ſhore; provided it prevented hindrance of buſineſs upon the rock: becauſe of time upon the rock, there was likely to be a great ſcarcity; but on the ſhore a very ſufficient plenty.

This made me turn my thoughts to what could be done in the way of *dove-tailing*.——In ſpeaking however of this as a term of art, I muſt obſerve that it had been principally applied to works of *Carpentry*: its application in the maſonry way had been but very ſlight and ſparing; for in regard to the ſmall pieces of ſtone that had been let in with a double dovetail, acroſs the joint of larger pieces, and generally to ſave iron, it was a kind of work even more objectionable than cramping; for though it would not require melted lead, yet being only a ſuperficial bond, and conſiſting of far more brittle materials than iron, it was not likely to anſwer our end at all.——Somewhat more to my purpoſe I had occaſionally obſerved in many places in the *Streets of London*, that in fixing the *Kirbs* of the walking paths, the long pieces or *Stretchers* were retained between two *Headers* or bond pieces; whoſe heads being cut dovetail-wiſe, adapted themſelves to and confined in the ſtretchers: which expedient, though chiefly intended to ſave iron and lead, nevertheleſs appeared to me capable of more firmneſs than any ſuperficial faſtening could be; as the *tye* was as good at the bottom as at the top, which was the very thing I wanted; and therefore if the tail of the header was made to have an adequate bond with the interior parts, the work would in itſelf be perfect.

What I mean will be rendered obvious by the inſpection of Fig. 3. in Plate N° 13.——Something of this kind I alſo remembered to have ſeen in BELIDOR's deſcription of the ſtone floor of the great ſluice at *Cherbourgh*, where the tails of the upright headers are cut into dovetails, for their inſertion into the maſs of rough maſonry below, and Fig. 4. of the ſame Plate is taken from BELIDOR's Plate *.

From theſe beginnings I was readily led to think, that if the blocks themſelves were, both inſide and out, all formed into large *dovetails*, they might be managed ſo as mutually to lock one another together; being primarily engrafted into the rock: and in the round or entire courſes, above the top of the rock, they might all proceed from and be locked to one large center-ſtone.——After ſome trials in the rough, I produced a complete deſign, of which Fig. 5. Plate 13. is the exact copy; the dotted lines repreſenting the courſe next above or below, which in the original was drawn from the ſame center, on the other ſide of the paper; ſo that looking on each ſide ſeparately, each courſe was ſeen diſtinctly; or looking through the paper, the *Relation* of the two courſes, ſhewing how they mutually broke joint upon one another, was clearly pointed out: and this method of repreſentation was purſued throughout; but not being practicable in copper-plate work, I am under the neceſſity of introducing the method by dotted lines, though attended with ſome degree of confuſion of the main deſign.

67. IN like manner, upon the ideas aſſumed, concerning the particular figure of the outſide of the building, with the draughts and models of Mr. RUDYERD's Lighthouſe before me; it was not long before I made out a fair ſection of a ſtone building, ſuch as to me appeared practicable on the principles before mentioned. Figure 6. in the ſame Plate, is a reduction of it to half the ſize of the original; which, with the copy of the firſt fair plan, ſhewing how all the ſtones compoſing the ſame courſe were to be mutually locked together, by a new method of dovetailing, I am the more inclined to inſert, as a part of this work; becauſe I eſteem theſe *Prototypes* more perfect in themſelves, as *a general* ſcheme, than what was on further conſideration actually adopted and executed; becauſe many things were obliged to be varied, in order to render the whole more ſuitable to the ſituation, which would not have been varied had it not been on account of particular conſiderations: and thoſe variations, together with the reaſons for the ſame, will be pointed out in the detail of the parts, in the progreſs of the work.

It is obvious that in this method of dovetailing, while the ſlope of the rock was making good; by cutting the ſteps (formed by Mr. RUDYERD) alſo into dovetails, it might be ſaid, that the foundation ſtones

* Architecture Hydraulique, Part II. Tom. I. Plate 26. Fig. 4. Page 272.

of every courſe were *engrafted* into, or rather *rooted* in the rock; which would not only keep all the ſtones in one courſe together; but prevent the courſes themſelves (as one ſtone) from moving or *ſliding* upon each other.——But after loſing hold of the rock, by getting above it; then, though every ſtone in the ſame courſe would be bonded in the ſtrongeſt manner with every other, and might be conſidered as conſiſting of a ſingle ſtone, which would weigh a conſiderable number of tons, and would be further retained to the floor below by the cement, ſo that when completed, the ſea would have no action upon it but edgeways; yet as a force, if ſufficiently great might move it, notwithſtanding its weight, and the ſmall hold of the ſea upon it; and break the cement before time had given it that hardneſs which it might be expected to acquire afterwards; I had formed more expedients than one, for fixing the courſes to one another, ſo as abſolutely to prevent their ſhifting; but deferred the choice of theſe expedients till a ſtone building had been approved and reſolved upon.——I alſo foreſaw that though the cement in the bed of each courſe, while remaining entire, by excluding the water, would in reality take away the whole tendency of the ſea to *lift* it; yet while a courſe was unfiniſhed, and the mortar not ſufficiently *ſet* or hardened, the violent action of the ſea upon the cement in that ſtate, might entirely waſh it out; and then the ſea would act in the ſame manner in lifting, as if there had never been any cement put in: I therefore formed a variety of temporary expedients to prevent this, while the courſe was *unfiniſhed*; for after a courſe was once finiſhed and the cement was hardened, there could be no danger of ſuch a thing happening: but I ſhall not trouble my reader with a recital of thoſe expedients at preſent, as they will more properly come in along with the reaſons of my choice, in the detail of the actual proceedings.

68. WHILE I was digeſting and ſettling my mind upon theſe matters, I had frequent conferences with Mr. WESTON, who had actually, two or three times, been upon the rock; and as from him I learnt that if I was then at Plymouth, a probability of landing upon the rock ſo early in the ſeaſon was not to be expected; I took ſo much time as maturely to arrange my thoughts, previouſly to a full explanation of my general ſcheme, and yet to leave time for the neceſſary preparatory ſteps, in caſe what I had then in contemplation ſhould not be approved of.——I therefore, as early as was conſiſtent with theſe circumſtances, deſired another interview with the body of Proprietors; when by the help of the two drawings above referred to in Plate N° 13. Fig. 5. and 6. I fully explained my deſign above ſtated; with which after mature conſideration, they declared their perfect ſatisfaction: and that the ſcheme, was not only in itſelf practicable; but, as appeared to them, the only means of doing the buſineſs *effectually* for the general good of the public.——They however obſerved, that though they themſelves were unanimous in this opinion; and though the condition of their receiving the *light* duties* was that of *maintaining* a light upon the *Edyſtone Rock*; and that though neither the form, nor materials of the building for that purpoſe were preſcribed to them; yet they thought it right, not to reſt the determination of theſe matters with themſelves only, but to have the concurrence of the Board of ADMIRALTY, and of other ſuperior opinions; which being taken, it ſeemed to them (on ſuppoſition of *their* approbation) that I ſhould not then have any thing to do, but to go down to Plymouth and prepare for the execution.

To this I obſerved, that we were not yet ripe for taking thoſe opinions; for at preſent the ſcheme was ſo much in *Embryo*, that it exiſted merely as a work of imigination, formed from the repreſentations and informations, I had *then* received: but that when I came to ſee the Edyſtone Rock, with my own eyes, and obſerved its nature and ſituation; it was a poſſible caſe, that I might *myſelf* be of a different opinion; and ultimately recommend a ſtructure as near alike, as we could tell how to make it, to the laſt. ——That the neceſſary ſteps ſeemed to be, that ſince the new ſcheme, had in its outlines been honoured with their approbation; it was now, or, as ſoon as the ſeaſon ſhould become likely to obtain a landing, would be proper for me to go to *Plymouth*, and make my own obſervations; and take ſuch exact dimenſions of the rock itſelf, as would be neceſſary to enable me to erect a ſtructure upon it of either kind: as alſo to examine into the nature and diſtance of ſuch materials, as ſhould appear to be neceſſary; by

* Viz. One Penny per ton upon all Britiſh ſhips, outward or homeward-bound, that paſs the Edyſtone; on, or from foreign voyages. One ſhilling per veſſel on coaſters; and double theſe duties on foreign ſhips when they come into Britiſh ports. The King's ſhips being all free.

which

which means, on my return, I ſhould not only be able to adviſe as to the ſort of building; but to make an exact model of the rock, and of the fabric I ſhould ultimately propoſe upon it; all which, if approved by the Proprietors themſelves, it would be then time to ſubmit it to the opinion of the ſuperior *Boards:* for, we ſhould cut but a ſmall figure indeed, if after having received their approbation, we ſhould find ourſelves under the neceſſity of telling them, that what we had propoſed was premature, and would *not do*; and that we were obliged to recur to the former conſtruction.

This propoſition being approved of by the Proprietors, it was determined that the Lighthouſe ſhould have the ſame *general Form* and *Conveniencies*, as the laſt; but as to the matter, whether of wood or of ſtone, or what kind of ſtone, ſhould be referred to my further enquiry and report.

It being yet rather too early in the ſeaſon, for my journey to Plymouth to be of any probable uſe, I employed the reſidue of my time in preparing ſuch inſtruments and neceſſary matters in London, as I foreſaw might be uſeful; however, to loſe no material time, it was concluded I ſhould ſet out for *Plymouth* on the 22d of March 1756, where I arrived on the 27th.

CHAP. II.

Containing an Account of the Proceedings and Occurrences on Mr. SMEATON's *firſt Journey to* PLYMOUTH *in the Spring of the Year* 1756.

69. IN my journey to Plymouth, I had nothing to regret but the loſs of time that I ſuffered, which was occaſioned chiefly by the badneſs of the roads.——Notice having been given of my coming, I had an early viſit from the perſons who expected me; and in particular from Mr. JOSIAS JESSOP, with whoſe general character, as given to me, I have already made my reader acquainted. To him I was principally referred for what information and aſſiſtance I might ſtand in need of; and had the ſatisfaction to find him perfectly to anſwer the character that had been given me of him: who beſides being an approved workman in his branch as a ſhipwright, I found a competent draughtſman and an excellent modeller, in which laſt he was accurate to a great degree; he therefore appeared to be a very fit perſon to overlook the exact execution of a deſign given.

To him I ſoon hinted the probability of building the houſe with ſtone, at which he ſeemed much ſurprized, and aſked me, how I meant to faſten the *outſide Timbers:* I told him, that if it was built with ſtone, I meant to uſe no timber at all about it; at which he was aſtoniſhed, and ſaid, it would be impracticable in that ſituation; or if it could be done, it *would not ſtand:* but on endeavouring to come at his reaſons for thinking ſo, I found it was no other than the idea of ſecurity, which had been generally conceived to have ariſen, from the rocking of the late wooden houſe.——After ſhewing him the ſketches of my deſign, and explaining the ſame to him, as I had done to the Proprietors, he ſeemed to be tolerably ſatisfied; and ſaid, that as I propoſed to do without cramps or iron, in binding the lower part of the works together, it would certainly be a great ſaving, both of expence, and, what in this caſe was more valuable, of *Time*.

He alſo obſerved to me, that the worms had brought on ſo general a decay in the foundation part of the late Lighthouſe, not only of the outſide timbers, which could eaſily be *ſhifted**, but alſo of the interior ground timbers, that ſeveral of them had in his time been obliged to be ſhifted; and that this generally proved an operation, not only tedious and difficult, but even in itſelf imperfect; as the new timbers put in, could ſcarcely be brought to an equal bearing with the others: and that in conſequence (the greateſt number ſhifted having been on the S. W. quarter) the whole building had got a conſiderable *Liſt* or leaning to the S. W. where the rock was loweſt; and that from this cauſe of decay,

* The term *ſhifting* a timber in *Shipwrightry* ſignifies in general the ſubſtitution of a piece of new timber in the place of a piece of old.

as well as the neceſſity of repairs, every year growing more and more preſſing, it muſt have become in a courſe of years, not only exceeding difficult, but very expenſive to have kept ſtanding; even if any adequate remedy ſhould have been found out againſt the worms attacking the new timbers, as many of the old ones were in a very decayed and porous ſtate at the time of the deſtruction of the late building.

70. I WAS impatient to go off to the rock; but though the wind was fair at N. W. which was the favourable quarter; yet it had blown ſo hard, that Mr. JESSOP aſſured me we could not effect a landing upon it for a day or two longer at the ſooneſt; I therefore turned my thoughts to other matters. ——I waited upon FREDERICK ROGERS, *Eſq*; *Commiſſioner* at *Plymouth Dock*, who with great civility and politeneſs aſſured me, that no aſſiſtance to my undertaking, which he could give, ſhould be wanting. I alſo went to ſome of the artificers recommended by Mr. JESSOP to give directions for tools, to make trial of the manner, and with what expedition we might be able to work the rock; and alſo inſtruments and utenſils to enable us to take a plan thereof.

71. THE 2d of April being the firſt day there was any probability of landing on the rock, we ſet ſail; it being at that time near the height of the ſpring tides, the wind eaſterly and moderate. We got within a ſtone's caſt of the rock, but could not attempt to land, as the ſea broke upon the landing-place. ——Though we could not land, yet as the tide was at its low ebb, I had a good view of the rock, and an early opportunity of correcting many errors that I had been led into by the incorrectneſs of the ſeveral models and draughts which had come to my hands; and indeed I never ſhould have had an adequate idea of this very turbulent place without ſeeing it.

72. ON the 5th of April we made our ſecond voyage, the wind at N. W. and very moderate, ſo that though we went out of *Sutton Pool* at Plymouth before the water began to ebb, yet we did not arrive at the Edyſtone till it was nearly low water; and then I was rejoiced with ſetting my foot, for the firſt time, upon the *Edyſtone*. We ſtaid there 2 ½ hours; that is, till the ſea began to break from the weſt ſide over the rock at the landing-place; which my experienced guides pointed out as the laſt warning for our departure. Having employed myſelf while upon the rock in taking a *general View of the whole*, I could not perceive any remains of the houſe, either upon it, or about it; except the greateſt part of the iron branches which had been fixed by Mr. RUDYERD; and ſome of the moorſtones, which might be diſcerned lying in the bottom of the *Gut:* we ſounded 12 feet water then upon them, which compared with former obſervations of Mr. JESSOP, ſhews that the Gut was filled up full two feet perpendicular, by their having tumbled into it, and there meeting with a place of repoſe.

I then obſerved ſuch traces of the ſituations of the irons fixed by Mr. WINSTANLEY, as that it would not be difficult to make out his plan and the poſition of the edifice; from whence it appeared very probable, that Mr. WINSTANLEY's building was overſet all together; and that it had torn up a portion of the rock itſelf along with it, as far as the irons had been faſtened in it.

On this view I ſoon perceived that Mr. RUDYERD's iron *Branches*, as then called, were much ſmaller and ſhorter than he had deſcribed them to be at the bottom of his print; that many of them were looſe, and ſome broken and bent: and I remarked that in regard to the ſteps, deſcribed to be cut upon the rock, there were only five of them, of which the traces were remaining: ſo that there was but one *flat* or *tread* of a ſtep above the center of the houſe; and the upper part of the ſurface of the rock above that, was a ſloping plain as it had been at firſt. Three ſteps, of the five now remaining, ſeemed to have been but faintly cut, and the uppermoſt but one was ſo imperfect, that I ſuppoſed a large *ſpawl* or ſplinter had come from it; and this appeared the more probable, as the uppermoſt ſtep was ſo ſhaken, that another large ſpawl might have been eaſily raiſed from it, by a ſlight action of a wedge. Above the uppermoſt ſtep the rock ſeemed to be of a ſofter nature, was cracked in many places, and probably had received ſome damage from the fire. None of the ſteps appeared to have been cut with much regularity, either as to level or ſquare; but to have all the marks of hurry upon them.——In the center of the houſe a ſlight footing was cut for the maſt, ſuitable to a ſquare of 18 inches, with large iron branches anſwer-

able

able to two of its ſides; and a ſmall hole bored in the center of about 1 ½ inch diameter, being ſix inches deep. By conſulting Plate N° 7. many of the above matters will be made apparent to the eye.

I then proceeded to try the degree in which the rock was *workable*, and found that from a flat ſurface indifferently taken, I could with a pick ſink a hollow at the rate of five cubic inches per minute; and could cut or drill a hole with a jumper of 1 ½ inch diameter, at the rate of one inch deep in five minutes. I alſo tried a method of forcing two holes into one by a ſquare flat-faced bruiſer, or *Pummel*; ſo that, if there ſhould be occaſion, I might be able to make a continued groove; or let in an iron branch, in the manner of Mr. RUDYERD, and I had the ſatisfaction to find that the whole ſucceeded to my wiſhes.

73. IN conſidering what had occurred, there was not any thing that put on the appearance of *Impracticability* in the fixing a ſtone building; but I was forcibly ſtruck with the idea that nothing would more immediately tend to expedite our work, than the ſecuring a more ſafe and certain landing; as by that means we might frequently be enabled to work upon the rock, when otherwiſe we could not land thereon, or get off again when landed. I therefore loſt no time in turning my thoughts to this ſubject, as a matter of great importance: for as I ſaw it muſt frequently happen, when the veſſels cannot get in, and muſt in ſuch caſe lie off the rock, waiting for a favourable time to enter the Gut; that in the interim, tides might change, ground ſwells come on, winds ſhift, and ſtorms ariſe, which would of courſe make it adviſeable to return to Plymouth, if poſſible, though the purpoſe of the voyage was unperformed: it ſeemed therefore of the greater conſequence that no practicable opportunity ſhould be loſt, for want of proper expedients.

At this time my knowledge of theſe ſources of uncertainty, in a great meaſure depended on the relation of others; but my own after-experience, in the courſe of the performance of this work, has moſt fully and amply verified them: and I may add, that when veſſels had got with ſome facility into the Gut, they frequently could not get out again without extreme danger: for as the larger ſort had not room to turn in it, they were in reality obliged to go out ſtern forward, in caſe they came in the right way: the *Sugar-Loaf* Rock (See Plate N° 3.) being ſo critically placed, and ſhallow water on both ſides of it, that it prohibits a thorough paſſage. Indeed I was told, that by the ſkill and expertneſs of thoſe ſeamen who had frequently attended the ſervice of the Edyſtone, not only row-boats, but the attendant veſſels, after having delivered their cargoes, had been carried quite through at the top of an high tide, with a fair wind and ſmooth water *; but this neither is, nor ought to be, attempted in common.

The two voyages I had made, were in a ſmall ſailing veſſel of about ten or twelve tons burthen, built on purpoſe for attending upon the late houſe by Mr. TOLCHER the agent, and was called the *Edyſtone Boat*. ——By the experience of theſe two voyages, it occurred to me, that while the Lighthouſe was ſtanding, if the boat ſhould have happened to be ſtaved upon the rocks, while lying in the Gut, there was a poſſibility of the men being ſaved by getting into the houſe, as the lightkeepers would have been ready to throw out a rope and aſſiſt them: but if any accident of the kind was to happen now that the houſe was down, and no ſhelter or protection to be had, there was but a chance of their being ſaved; and theſe conſiderations being likely to caſt a damp upon every exertion to land, I determined to go out no more without another ſailing-boat to *attend*, and accordingly hired a fiſhing veſſel of an equal ſize with the Edyſtone boat.

74. THE 9th of April the wind and weather having become favourable for another attempt, we ſet forward at midnight between the 9th and 10th, the wind being then at N. W. and ſo moderate, that to expedite our paſſage we uſed our oars: but by the time we got a-breaſt of the Ram Head, it had veered to S. W. and began to blow ſo hard, that in three hours, finding we had made little progreſs towards the Edyſtone, we returned and re-landed at Plymouth at ſix in the morning †.

* The *Sugar-Loaf* is overflowed at half tide in ſtill water.

† The mention of this voyage might very well have been ſpared; but the brief recital of it, and of ſuch other fruitleſs attempts as occurred upon *this* viſit to Plymouth, will ſerve as a ſample, and (better than any form of general words) make my reader ſenſible of the great difficulty and uncertainty that naturally attends the landing upon the Edyſtone Rocks.

It was not till the 14th that we had any proſpect of ſucceſs at ſea; the intervals between theſe attempts were therefore filled up in looking out a place proper for a work-yard; which to anſwer the purpoſes of a ſtone building, I conſidered ſhould have the following properties: 1ſt, That it ſhould be acceſſible not only to the boats or craft immediately employed in the ſervice, but to ſuch larger ſloops and veſſels as were to be employed in bringing ſtone from the reſpective quarries: for this purpoſe, it was neceſſary, that there ſhould be a wharf or quay, or the capacity of erecting one; againſt which there might be nine feet, or at leaſt eight feet depth of water at the high water of *Neap* tides. 2dly, That this ſhould be in a harbour, interior to that of *Plymouth Sound*, where veſſels might lie ſheltered and in ſafety from all winds. 3dly, That it ſhould be readily acceſſible to veſſels coming in with their cargoes from the ſea. 4thly, That the navigation outward for our own craft to the Edyſtone, ſhould be attended with as little intricacy, difficulty and uncertainty, as poſſible; in ſhort, that there ſhould be no material obſtruction to their getting out at high water into Plymouth Sound. 5th, and laſtly, That there ſhould be a level area to the amount of about 50 yards ſquare, or a capacity of making ſuch a one.

With this view I ſearched all the likely places I could hear of in and about Plymouth, to the amount of eight or ten in number; but found them all to be wanting in ſome of the requiſites; or previouſly occupied in ſuch a manner as to make it too expenſive for us to acquire an eſtabliſhment in them. It is unneceſſary to mention the particulars and the reaſons for rejection, except what relates to one of the ſituations, that had been the work-yard of my predeceſſor, and on that account may deſerve a more particular notice.

This place, which is called *Emparcombe*, tradition has pointed out to be the ſpot where Mr. RUDYERD framed and fitted up his works ready for the ſea. It is ſituated upon the eaſt ſide of an interior bay that proceeds from the *Hamoaze** behind *Mount Edgecombe* †. The principal trace that remained of his works, was a row of cottage-houſes, ſaid to have been originally erected for the lodgment of himſelf and his workmen‡.——From the diſcretion that Mr. RUDYERD had ſhewn in his general proceedings, I could not doubt but that this place which he had pitched upon, muſt fully have anſwered his purpoſe: but as, in caſe of a ſtone building, the tonnage of the materials to carry off, was likely to be conſiderably more than double of Mr. RUDYERD's, I found it very indifferently ſuited to mine; for it ſeemed wanting in every requiſite except the ſecond; and was peculiarly defective in the firſt: and I could ſcarcely imagine he had made choice of it for any other reaſon, than that of his workmen being retired from the buſtle that attends the town of Plymouth in time of war, and that it did not in the leaſt interfere with the King's works.

Indeed I found no procurable place, completely made to my hands; but that which ſeemed the moſt nearly to contain all the requiſites, or the capacity of making them, was in a field adjacent to *Mill Bay*, about a mile weſt from Plymouth. This bay, and particularly the weſt ſide of it, was well ſcreened from all winds, for all kind of veſſels that we could want. Its entry was ſufficiently wide, but yet not too much ſo; the water deep and the headlands bold: and though the mouth is well protected from the ſurge of the *Sound*, by the iſland of *St. Nicholas*, now more generally called DRAKE's iſland; yet the paſſage out to the Sound, as well as the coming in, is very eaſy and ſafe. The greateſt objection was, a want of depth of water towards the weſt ſhore; eſpecially where, in other reſpects, the ground lay the moſt commodious for a work-yard: but it appeared that this inconvenience (amounting to about three feet want of depth in the ſhalloweſt part) might be remedied by firſt clearing a paſſage through the mud, and then ſinking the natural bottom, which appeared to be a ſtrong hard clay, ſo as to form a channel of ſufficient width for the paſſage of veſſels: and thus the buſineſs as to the obtaining of a work-yard was brought to a point ready for application to the proprietor of the field. See Plates N° 2. and 17.

75. THE weather ſtill continuing unfavourable, my next excurſion was to viſit the neareſt place to Plymouth where *Moorſtone* which in reality is the true *Granite*, was found and worked; and that was

* The *Hamoaze* is that part of the harbour oppoſite the *King's Docks* near Plymouth; being the broad outfall of the river *Tamar* into the Sound.

† See the Plan N° 2 of Plymouth Sound, and of the interjacent ſea including the Edyſtone.

‡ In the year 1787 I found at this place more reſpectable buildings.

about

about fifteen miles from Plymouth, up the river *Tamar*, near *Calſtock*, to which place I underſtood that river was navigable. The moorſtone is found upon *Hingſtone Downs*; and here I was firſt ſhewn the method of working it: which was by ſplitting it with a great number of wedges applied to holes or notches, cut (or, as they term it, *pooled*) in the ſurface of the ſtone, at the diſtance of about four inches, more or leſs, according to the ſize and ſuppoſed ſtrength of the ſtone. Theſe pool-holes are ſunk with the point of a pick, much in the way that is done for the ſplitting of hard quarry-ſtones in general.——Here I was informed, that the harder the quality of the moorſtone, the more exactly in general it could be ſplit to the ſize or *ſcantling* required; and on the contrary, that the more ſoft and capable of being worked with the pick or other tool, the leſs regularly it would ſplit: ſo that to bring this kind of ſtone to a true ſquare, would require in the whole, near the ſame quantity of labour, whether of the harder or the ſofter ſpecies.——The moorſtone of this place ſeemed to be of the harder ſpecies; but of the quantity remaining, the ſtones were not of ſo large a ſize as I expected to have met with.

In enquiring as to the prices of the work, I foreſaw it would be to no purpoſe to aſk the expence of ſhaping ſtones to the particular figure I wanted; becauſe the workmen being totally unuſed to any work of that ſort, the queſtion would only have puzzled them, and the anſwers of courſe would at beſt have been indiſtinct, if not tending to miſlead: I therefore founded my enquiries upon the price at which they could produce *Aſhler* *, by the foot ſuperficial, when brought to a true ſquare; and what was their price per gallon in forming ſtone *Troughs*, ſome of which I found they were in the practice of making. By anſwers to the firſt, I was enabled to form a judgment, at what price they could work moorſtone by the foot, to a perfect regularity, after it was ſplit into the proper ſcantlings for that purpoſe; and from the price of working out the hollows of ſtone troughs, I could judge of the expence of hollowing out the work by downright dint of labour of the pick, where no advantage could be derived from the uſe of the wedge or the hammer.

The operation of ſplitting granite is very curious; for, the apparent texture being without any particular direction, the parts ſeeming to be irregularly and coarſely huddled together, ſomewhat reſembling a *Plumb Pudding*; one would not imagine, that any degree of regularity could take place in their diviſion by ſplitting; but the caſe is ſo far otherwiſe, that gate-poſts are afforded in the rough ſquare, at a very moderate price; and I have in this country frequently ſeen poſts of *Granite* twelve feet long, and not above eight inches ſquare, uſed inſtead of wood, for the mere purpoſe of ſupporting a *Hovel*, no part of them being ſo much as an inch out of ſtraight, or flat: but it is to be conſtantly obſerved, that the ſtrength of the ſtone, on each ſide of the biſection, is ſo managed, as to be nearly equal, otherwiſe the *ſplit* will conſtantly encroach upon the weaker ſide. Indeed without this remarkable property in granite of ſplitting regularly, it would have been of little uſe in human life: for it is of ſo hard a nature, that ſteel will not *cut* it; and yet hard ſteel will *bruiſe* it; ſo that the prominent parts being gradually crumbled away by repeated blows, its ſurface can be brought to a great degree of regularity: and as the ſplitting procures plain ſurfaces nearly regular, as already obſerved, the accidental prominences can be reduced to regularity by a moderate degree of labour.

76. ON the 14th of April we went out to ſea between five and ſix in the morning, for the *fourth* time, the wind being then at Eaſt, and very moderate; but it had been at N. W. the preceding evening, which determined us to get every thing ready for the morning's tide. We had ſcarcely got out of the Sound before it became more freſh and veered to the S. E.; appearances were now againſt us, but I determined to run out to the Stone; for though it was not very likely we ſhould effect a landing, yet as the wind was fair to run to the harbour of *Fowey*, or as it is commonly called *Foy*; a port about ſix leagues to the N. W. from the Edyſtone, and a place I wanted to viſit on account of there being in that part of the county, a much more conſiderable quantity of moorſtone, as well as hands employed in working it, than I had yet ſeen, we proceeded in our voyage. As we ran further out, the wind became more freſh, and when we got out to the length of the Edyſtone, it blew hard: there was no poſſibility of

* A term uſed by maſons for ſtones prepared in the ſquare for building with regular courſes.

landing; but I cauſed our boat to lie off and on, at the diſtance of about one hundred fathoms, to obſerve the action of the ſea upon the rocks, when the wind blew from the S. E. quarter; which indeed was very violent, the ſeas being broken into a very large and heavy ſpray. On ſteering for *Fowey* we ſtood before the wind, and therefore though the gale increaſed, ſtill our little boat and attendant behaved very well: we however had ſo much ſea as to make a ſafe harbour very acceptable to us; and as Fowey was pointed out to me, as a place of refuge when the wind came round in ſuch a manner as to prevent our return to Plymouth, it became expedient to examine its moſt material properties with attention.

The entrance of this harbour is rather narrow for large ſhips; but the headlands are very bold, and there is nothing to fear but what is in view. There is deep water both in the entrance and in the harbour itſelf, which is conſiderably enlarged in width after paſſing the headlands; in ſhort, when you are in it, it is both ſafe and commodious.——As the depth of the water enables merchant ſhips of almoſt any ſize to go in or out, at any time of the tide, when the wind ſerves, this harbour becomes of conſequence; being critically ſituated in the bottom of the extenſive bay formed between the *Ram-Head* and *Deadman's* Point; and where many good ſhips, had mariners been *ſufficiently* acquainted with it, might have found a ſafe retreat from bad weather and ſhipwreck; it is therefore to be lamented, that from erroneous accounts, formerly given in ſome of the pilot-books concerning this harbour, ſhips have not ventured to go into it, when they might very ſafely have done ſo, owing to the falſe idea entertained of it; which was that of its being a tide harbour, with a *Bar* at its mouth; than which nothing can be more contrary to the truth.

In fact, *Fowey Harbour* may be called the *Key* to the Edyſtone ſervice: for as from the Edyſtone, Plymouth Sound and Foy Harbour lie nearly at a right angle; when it blows right a-head from Plymouth Sound, a veſſel ſteering to Foy will have the wind upon her beam; and as this will be a wind from the land, there never can be any great ſea from that quarter, at ſo moderate a diſtance from the ſhore; ſo that any good ſea-boat, may make her courſe good to Fowey: and ſhould the wind be due North, a veſſel may yet run under ſhelter of the Deadman, and afterwards *turn into* Foy: but if the wind is to the Weſtward of the North, ſhe may then run under protection of the high land at the *Bolt* point to the Eaſtward, and get into a ſmall harbour called *Yealm*; though in the courſe of my experience, we ſeldom had occaſion to uſe it: for it never happened when the wind was too far to the Weſt to get into Fowey, but we could always fetch Plymouth Sound, by making a ſingle *Tack* or two at the moſt.

77. NEXT morning the 15th, the wind blew hard at S. W. we therefore ſet out for *Lanlivery*, about ſix miles from Foy; and here we found WALTER TRELEVEN and ſon, to whom I was directed as the principal people in this diſtrict for working of moorſtone. WALTER aged 60 acquainted me, that he worked at the ſtone-work for the late Lighthouſe under his elder brother PETER TRELEVEN, who had the contract under Mr. RUDYERD. He informed me, that none of the ſtones uſed therein were above a ton weight; that they were all cramped with iron, each to its neighbour; and the outſide courſes to thoſe below; but ſo, that none of the cramps could be ſeen on the outſide; that they were all finiſhed at that place, being *tried* together upon a flooring of boards, and the cramps let in, and that the cramps were made from a pattern he had from Mr. RUDYERD.——PETER TRELEVEN, aged 80, was ſtill alive, but ſo infirm and ill that he could not ſee us: I therefore deſired his brother WALTER to aſk him a few queſtions; and particularly whether there was any kind of mortar or cement uſed in the ſtone-work; it being Mr. JESSOP's notion, from what he had obſerved, that there was not, which PETER TRELEVEN confirmed: but it ſeems that neither he nor WALTER had ever the curioſity to go upon the Edyſtone Rock.

We then went to ſee the ſtone, and the way by which it was to be carried down to the water ſide to be ſhipped. The pieces of ſtone are here in general of much larger ſizes than thoſe we ſaw at *Hingſtone Downs*, and are of a quality much more free to work, but will not ſplit ſo true, as I had before been informed. I ſaw one ſtone apparently without crack or flaw, which curioſity prompted me to meaſure, and found it to contain no leſs than 400 tons *. The diſtance of the place of working the moorſtone to *Parr*, the place

* The moorſtone or granite of this country that is wrought for ſale, not only at this place, and at Hingſtone, but every where that I have

place of ſhipping it, is about three miles, through very bad roads, and by means of carriages but indifferently contrived, which in this country they call *Ploughs*: they were not then in practice of drawing above a ton and a half at a time, and to move this, they were obliged to yoke a team, conſiſting of a great many bullocks and horſes. I made ſimilar enquiries here, to thoſe I made at Hingſtone, to aſcertain the price of work, and found it upon the whole to amount nearly to the ſame as there. The ſtone here, though of a quality conſiderably ſofter, was yet very ſufficiently hard for any purpoſe of building, and equally unperiſhable by the effects of weather, with the hardeſt: and as the quality of its being more eaſily to be worked with the pick, ſeemed better adapted to produce the dovetail ſhapes I had in view, at a moderate price, and as ſtones could be got here of any ſize that could be moved from the place, the ſtone of this diſtrict ſeemed upon the whole more likely to ſuit my propoſed operations, than what I had before ſeen.

We were informed that a great part of the ſtone wherewith the walking paths of *Weſtminſter Bridge* were laid, were gotten from this place. It diſtinguiſhes itſelf, by being of a much coarſer grain, with long white ſpar-like pieces, frequently of two inches and upwards in length, and which from ſimilarity they there call *Dog's Teeth*; whereas the moorſtone of Hingſtone, was of a ſmaller and cloſer grain, and much interſperſed with the black *Mica* or *Talc* which is one of its component parts.——The morning of Saturday the 16th, the wind ſtill continuing freſh at S. W. we this day took the opportunity of returning to Plymouth by ſea from Fowey*.

ON Sunday and Monday the 17th and 18th, it blew very hard at N. W. On Tueſday morning the 19th, the weather being very fine, clear and calm, we went out the *fifth* time for the Edyſtone; but the little breeze there was being right a-head, we tacked and rowed the whole day; and at night found ourſelves about four miles from the rock. As the day was perfectly ſerene, we had the mortification of ſeeing every thing calm and quiet about the rock, without being able to get near it. Upon the turn of the tide in our diſfavour, we dropt anchor, in hopes of completing our voyage the next day's tide; but in the night it began to rain and blow ſo hard from the S. E. that we were glad to weigh anchor and come home; and in returning, the wind veering to the N. E. and blowing very hard almoſt right a-head, we had a laborious work in turning to windward and regaining Plymouth.

The event of this laſt voyage pointed out to me very ſtrongly, that the much greater tonnage of the ſtone, which muſt be neceſſary to be carried out and fixed, in caſe of a ſtone building, than was neceſſary in the compoſitions of my predeceſſors, would make the uncertainty and delay that they have deſcribed to be attendant upon their voyages, in order to fix their work, bear far heavier upon my ſcheme than upon theirs; and thereby occaſion the whole time of the performance to be lengthened; a circumſtance that would be very diſagreeable to all concerned. It therefore appeared to me, that had a veſſel been fixed within a quarter of a mile, or ſome ſuch competent diſtance from the rocks, and which ſhould be capable of lodging the workmen with all their tools, and looſe materials; the ſeveral pieces of wrought ſtone only excepted; that then the workmen might by means of ſmall row boats or *Yawls* have effected a landing both of themſelves and their materials; and have been at work upon the rock the greateſt part of that day; which we, as voyagers, loſt the whole of in fruitleſs labours and endeavours, to get to the place of action. On conſulting Mr. JESSOP upon this idea, he recommended that we ſhould build a ſtrong and very well *found* ſloop of about 50 tons burthen, with iron chains for mooring her upon the rocky ground, which, as has already been obſerved, every where prevails in the vicinity of the rocks of the Edyſtone: and that her inward lining or *cieling*, as it is termed, ſhould be *caulked* equally well with the outſide planking: ſo that the outſide planking might then ſuffer great derangement, and even be in part

I have had an opportunity of obſerving it, is not produced from quarries; but lies in pieces, generally roundiſh, upon the ſurface of the earth, ſomewhat ſunk into the ſame; and this is uſed in preference, as being the moſt eaſy to come at: but the *Miners* find, that it lies underground in very thick and ſolid *Strata*, through which they are frequently obliged to ſink *Shafts* or pits, for a great number of fathoms. It is called *Moorſtone* from its being generally found upon the high grounds of this country, which are chiefly moors.

* Doubtleſs it was this port that Mr. WINSTANLEY mentions, § 18, that he was frequently obliged to go to for ſhelter, and that it took him the greateſt part of the next day to get back to Plymouth.

deſtroyed

deſtroyed by touching upon the rocks, while the inſide remaining entire and water tight, would be ſufficient for the buoyancy of the veſſel; and if ſloop-rigged, ſhe would lie very ſnug and cloſe while at her moorings; and in caſe of being accidentally broken looſe by a heavy ſtorm, ſhe would be eaſily manageable and got under way, ſo as to be able to reach *ſome* port; either Plymouth, or to the Eaſt or Weſt, and be eaſily replaced after the gale was over. To this ſcheme there appeared only one objection, and that was the difficulty there might be in clearing the water from between the *Plankings*; but that it ſeemed, might readily be obviated by making two pumps; one to act between the plankings, and the other within the veſſel. But being apprized that a veſſel was then fitting out in the river *Thames*, with chain moorings, not only to enable her to lie upon the rocky ground; but to continue there all winter, as a temporary *floating Light*; in ſome degree to ſupply the want of a Lighthouſe; we concluded, that in caſe this veſſel was ordered to be moored ſufficiently near the rocks, to anſwer the double purpoſe of the *Building* and of the *Light*; that, provided there was ſufficient room and accommodation, the expence of the *Store-Veſſel* above propoſed might be ſaved; and therefore it was proper to poſtpone our putting any thing in hand relative to this object, till the determination in reſpect to the floating light-veſſel was known: and in caſe that did not turn out to our purpoſe, the other expedient might then be adopted.

79. DURING this interval on ſhore, I occupied myſelf in various miſcellaneous matters, and in procuring the beſt information I could of ſuch things as it appeared neceſſary to have ſome knowledge of before the principal work was ſet about. In particular, on repeating my viſit to *Commiſſioner* ROGERS, he took an opportunity of ſhewing me a piece of *Portland Stone*, that had been cut out from a part of the *King's Docks* there, which had been wholly lined with that material.——This ſpecimen had been drilled with a great number of holes, ſomething ſimilar to the perforations made by the worms of ſhips; and as this had doubtleſs wholly happened ſince the ſtones were placed there, it was a circumſtance of a kind ſomewhat alarming. Theſe holes I obſerved had been made by a ſmall kind of ſhell-fiſh, ſomething like a muſcle, and that they were in general much ſmaller at the entry on the outſide, than they were within; and apparently enlarging as the ſhell of the fiſh had grown in ſize. I was further informed, that theſe holes had appeared moſt numerous, or at leaſt were of the moſt material ill conſequence, near the draw-gates of the ſluices, by which the water is drained off from the docks: for by this means, thoſe ſluices had become ſo leaky, that it became neceſſary from time to time to cut out ſeveral of the injured ſtones, and replace them with new ones.

Afterwards in looking among the marble rocks upon the ſhore of *Mill Bay*, near the place I had pitched upon as proper for our work-yard, I found ſeveral detached pieces of thoſe rocks, that had in like manner been drilled through, reſembling a honeycomb; and I likewiſe found ſome, near low water mark, where the ſolid rock had been entered in the ſame manner; from which I perceived, that the Portland ſtone had not ſuffered merely on account of its want of hardneſs; for the marble, which is much harder, ſeemed to be equally penetrable; nor had the pieces thus pierced ſuffered any decay in the nature of a rot; becauſe the intermediate parts, between the holes, ſeemed to retain their original hardneſs: from theſe circumſtances it appeared probable that every kind of *calcareous* ſtone might be ſubject to the like defect; and therefore that *Portland* ſtone ought not to be uſed for the *outſide* of the Edyſtone Lighthouſe, eſpecially of the lower works: though it might be uſed with great advantage for the works within, on account of the greater eaſe with which it might be wrought.

I was not indeed led into this opinion, by any doubt I entertained that a houſe built entirely with this ſtone, would laſt much longer than a wooden fabric would have done; but in contemplating the uſe and benefit of ſuch a ſtructure as this, my ideas of what its duration and continued exiſtence ought to be, were not confined within the boundary of an *Age* or two; but extended themſelves to look towards a poſſible *Perpetuity*: and though it did not abſolutely appear from what I had ſeen and heard, that a Portland ſtone building placed upon the Edyſtone rock, would in fact be penetrated by this kind of ſhell-fiſh; which ſeemed to be in a great meaſure confined to, and under *low Water-mark*; yet in caſes where it is not neceſſary, it is certainly unadviſeable to run the leaſt riſque; for no one can ſay *what* the difference

difference of ſituations may effect: and though the building, if attacked by any kind of known animal, might very reaſonably be expected to endure much beyond the term which I underſtood the Proprietors had in their preſent grant; yet as I knew it to be agreeable to their wiſhes, I concluded that to give it all poſſible ſafety and probability of permanency, it would be adviſable to make uſe of *Moorſtone* for the foundation, if not for the whole of the outſide work; it being of a quality not found either liable to be impaired by the above means, or ſubject to any kind of decay whatever by the injury of weather or time.

The owner of the fiſhing-veſſel that had hitherto attended us, being weary of the ſervice, I hired a ſloop of 25 tons burthen, with a commodious cabin, and decked over; but being too large to go into the Gut, it could only lie at an ancher, and be uſed as an attendant *Store Veſſel.*

80. THE 21ſt of April, the wind came about to the N. W. and was moderate; I therefore determined upon another attempt, and accordingly at twelve at night, went on board and proceeded on our *Sixth* voyage. We had a light breeze from the North, which carried us out leiſurely to the Edyſtone, without the leaſt difficulty, where we were ſo happy as to effect a landing between five and ſix, on the morning of the 22d; it was then nearly low water, and the tide at dead of the neap. The day being perfectly ſerene, we ſtaid upon the rock till twelve at noon; which was till after high water: and though the ſea at half a mile's diſtance appeared as ſmooth as the *Thames* in a calm day, yet a ground ſwell from the S. W. frequently run up very high upon the rock; and twice, a little after high water, ran over the higheſt point of it, though the dead level of the ſurface of the ſea at high water, was full nine feet below the ſummit. My operations being now diſturbed, we retreated to our veſſels till two, when we again landed, and I went on with my buſineſs till nine in the evening, having worked an hour by candle-light.

The weather continuing fine, the Edyſtone boat lay in the Gut all night, a thing ſcarcely ever before attempted: the ſloop to which Mr. JESSOP and I retired, lying at half a mile's diſtance to the North. At five next morning the 23d, I again landed and purſued my operations till eleven, when being a ſecond time interrupted by the ground ſwell, we went to the ſloop for refreſhment, with an expectation of recommencing the work at two o'clock, as we had done the preceding day: but about one o'clock the wind began to freſhen from the S. W. and at two it blew ſo hard, as to render our attempt to row the yawl into the Gut ineffectual. The wind ſtill increaſing, we lay at our anchors till five, in hopes of a change for the better; and then our ſituation became ſo uneaſy that we made a ſignal for Plymouth, where we arrived at half paſt ſeven, which, though with the wind very freſh, and in our favour, was looked on as a quick paſſage.——In lying off the rock with the wind ſomewhat freſh at S. W. I obſerved on the retreat of the tide, that when the ſeas broke againſt the overhanging *Breaſt* of the rock on the Weſt ſide, ſee Plate N° 9. the broken ſea would fly 30 or 40 feet high; whereas a much greater ground ſwell at high water, meeting only with the regular ſlope, though it mounted much higher bodily, yet ſcarcely broke at all.

81. IN this place, I think my reader will expect ſome general idea of what had employed me upon the rock for three ſucceſſive tides, amounting in the whole to full nineteen hours; and this was the taking ſuch dimenſions as would enable me to make an accurate model of ſuch part of the ſurface of the rock as we were likely to have any concern with in the rebuilding: and which was principally effected by the application of an inſtrument that I had prepared on purpoſe; the idea whereon it was contrived I took from LEON BAPTISTA ALBERTI's treatiſe of *Statues*, added to EVELYN's tranſlation of FREART's *Parallel* of *Architecture*. Wherein placing a kind of dial upon the head of the ſtatue, with an index or ruler, turning about on the center of the dial, and from this ruler letting fall perpendicular lines, the ſeveral parts of the inſtrument will ſhew the ſituation, diſtance from the center, and depreſſion of any given point of a ſtatue below the plane of the dial, that the artiſt is deſirous of aſcertaining for his guidance; which inſtrument he calls a *Definitor*.

With this intent, I brought with me from London, the plate and index of a large *Theodolite*; being a foot in diameter, and ſufficient to ſhew the ſingle minutes of the degrees of the circle. This plate I ſcrewed firmly down upon the ſurface of a ſteady wooden three-legged ſtool, which when ſet level, would overtop every part of the rock.——Being ſet up, it was ſo adapted to the rock, that the center of

the Theodolite was, as nearly as I could place it, perpendicularly over that hole in the rock, which I conſidered as having been the center of the late building; and the whole was adjuſted to marks now fixed upon the rock, ſo that it could be taken down and ſet up, as often as we might have occaſion; and ſo as preciſely to anſwer the ſame poſition of parts.——To the index of the Theodolite was ſcrewed a ruler, 16 feet in length, and divided into feet, inches and parts of inches, commencing from the center. This ruler was preſerved from bending by its own weight, in any material degree, by a *Rib* raiſed upon its upper ſide; and it could be brought juſtly horizontal by means of a pocket *Spirit-Level* being placed upon it. The figure and manner of uſing it will be ſeen in the Elevation of the rock, ſhewn in Plate N° 7. ——It is obvious that this index-ruler being carried horizontally round, along with the index of the Theodolite, would ſucceſſively paſs over every point of a circle of 32 feet in diameter: and that, a perpendicular being let fall from it, ſo as to anſwer to any point given upon the rock, within that area, the index would mark the degree and minute of the circle in which it is placed. The diſtance of that perpendicular from the center of the inſtrument would ſhew its diſtance from the aſſumed center of the former building; and the height of the perpendicular would ſhew the dip or depreſſion of the given point below the plain of the inſtrument. The two former will be ſufficient for laying down an exact *Plan* of the ſurface of the rock, as reduced to an horizontal plane; and this plan, being laid upon the plain ſurface of a proper block of wood or ſtone, and holes being drilled into the block from the reſpective points, at right angles to its plain ſurface, and to depths taken from the ſame ſcale as the plan was made by, will aſcertain the reſpective points within the block, ſufficiently for the forming a proper *Model* thereof.——The neceſſity of an exact performance of this part of the work, was proportional to the difficulty I had to get the proper meaſures taken; and indeed I was the more deſirous that every thing relative hereto ſhould be done with accuracy, as by that means many voyages and viſitations would be ſaved, in adapting the work to the rock, in the courſe of our future proceedings.

As we were liable to be expoſed to freſh gales of wind through every ſtage of our operation, there was no truſting to the perpendicularity of *Threads* and *Plumbets:* I therefore purſued the following method. ——Having made indelible marks with the point of a jumper, upon the ſurface of the rock, at all notable places, I had a wooden meaſuring rod of about twelve feet long, and 1¼ inch ſquare, divided into feet, inches and parts of inches, beginning from the bottom; this was ſhod with a rounded end or ſhoe of iron, which being ſet upon the mark to be aſcertained, the rod was put into a perpendicular poſition, by means of a carpenter's ſquare, having a ſpirit-level fixed upon one of its *Limbs*, the other limb being alternately applied to two ſides of the rod, at right angles to each other. It was ſteadied in that poſition, by temporarily applying two ſlips of deal, as *Shores* to two of its ſides that were at right angles; ſo that the lower end of the ſhores *ſtepping* againſt ſome hole or prominence of the rock, the bottom of the rod, together with the lower ends of the two ſhores, would form the baſe of an oblique triangular pyramid; while the part where the ſhores were held faſt to the upright rod formed the *Apex* of the pyramid*; this rod by this means was retained very ſtiff and ſteady in a perpendicular poſition.——The upright rod being thus fixed, the index-ruler was brought round, till it ſtopped againſt the upright rod, and then was ſhoved up, or let down by a ſhorter piece of a rod, ſlided againſt the upright one, till the index-ruler was brought to be truly horizontal, by means of the ſpirit-level being laid upon it: thus the upright rod would mark upon the index-ruler the diſtance from the center; and that ruler would mark upon the upright rod, the dip of the point on which it ſtood, below the level of the inſtrument; the braſs index at the ſame time ſhewing the degree and minute.——In this way I took off 35 in number of the moſt remarkable points, within the limits above-mentioned; obſerving to have one at each end upon the plain flat part of each ſtep, and ſo placed, that a line might be ſtretched between them from the point marked at one end, to that at the other end of the ſame ſtep, without its being interrupted by the branches, or other impediments.

It might ſeem at firſt ſight, that 35 points ſo determined, within a circle of 32 feet diameter, might be ſufficient to lay down the included area, but in reality it was not ſo; for when I had taken three times as many more, I had not completed the obſervations and meaſures I wiſhed: the rock itſelf, as well as the work my predeceſſors had made thereon, being ſo very irregular.——Theſe 35 primary points having been

* The rods were here *laſhed* together by a packthread.

determined

determined as above, the reſt were obtained from them as follows. A primary point being fixed at each end of each ſtep, between which a line could be ſtretched as before noted, the iron ſtanchions and particularities of each ſtep were readily taken off upon their own level reſpectively, by means of parallels and perpendiculars: and by ſtretching a line between any other two of the primary points given, that were neareſt and moſt advantageouſly ſituated, the ſituation of any other points wanted could be determined.——On my return to Plymouth, I made ſome progreſs in laying down to a ſcale, the meaſures taken upon paper. This enabled me to turn my thoughts towards a *real* deſign, which before had been only formed from imagination, aſſiſted by ſuch circumſtances as I could lay together from former drawings, models and verbal relations.

82. THE 28th of April the weather turning out more promiſing than it had been ſince our laſt return, I determined to attempt a *Seventh* voyage; and accordingly went on board, and lay in Cawſand Bay that evening, to be ready for the firſt of the tide next morning. Our outſet was favourable enough, but we had not got above a mile ſouth of the Ram-Head before a freſh of wind from S. E. came on, and ſo ſuddenly, that our boat, which the ſeamen were heaving into the ſloop, filled with water, and narrowly eſcaped being loſt. We notwithſtanding purſued our voyage towards the Edyſtone, but the ſea breaking with violence upon the landing-place, we could not attempt to land. However having received information of another place, where moorſtone was worked, which might be got to the waterſide, not far from *Falmouth*, and the wind being now fair for that port, we *bore away* for it, and arrived there in the afternoon. The next morning, we went on horſeback to *Conſtantine*, a place about four miles from Falmouth; where I applied to Mr. MATTHEW BOX, to whom I had been directed at Falmouth, as being the principal and almoſt the only man for moorſtone in theſe parts.

The moorſtone here, appeared to be of a quality, better both to cleave and work, than any I had before ſeen; for I obſerved by a piece of it, then under the hands of Mr. Box, that it might be cut and formed with a much ſuperior degree of execution, than I had before conceived this ſort of ſtone to be capable of.——He was at this time executing a *Grave-ſtone*, of the elevated kind, of which the pedeſtal of a column gives the idea; and in which he had formed the mouldings with ſo much delicacy and propriety, that I could not help conſidering Mr. Box as a capital artiſt in that kind of material; and therefore felt a ſecret joy in meeting with ſuch a perſon.——Such however is the nature of man, that he may be great in one branch of his profeſſion, and remain ſmall in another: for on communicating the nature of my deſign to him, I quickly found, that he conſidered the forming and erecting of a well ſhaped *Tomb-ſtone* of *Granite*, as the greateſt of all human performances; and that having lived and been brought up in a retired part of the country, from whence there never had been any conſiderable demand for moorſtone, in point of quantity, he had chiefly applied himſelf to the finiſhing of ſmaller works for the gentlemen of the county within a moderate diſtance from him. He ſeemed therefore rather frightened than pleaſed, when after I had explained a little of the nature and form of the work I ſhould be likely to need, I mentioned the extenſive order that I might poſſibly give for this article; for, to the execution of it he formed numerous difficulties, and did not know what to aſk, either for his ſtone, his work, or for the carriage down to Falmouth.

On conſidering the reſult of this interview with Mr. Box, and having now examined all the places I could hear of, where moorſtone was worked, which lie tolerably convenient for water carriage to Plymouth; I became convinced of the neceſſity of making uſe of Portland, or ſome other free working ſtone for the inſide work: for the granite, though preferable to all others in point of duration; yet being at beſt of a ſtubborn nature, and the working thereof confined to few hands, I perceived there would be no poſſibility of procuring ſo great a quantity in any reaſonable time, at a moderate expence, as the whole houſe would take, eſpecially if worked in ſuch forms, and in ſo large pieces as would be required upon the principle of my firſt ſketches.——The difficulties alſo that equally occurred to them all, as to the *Land Carriage*, ſeemed to induce the neceſſity, not only of confining the moorſtone to the outſide, but to take advantage of connecting thoſe with larger and heavier ſtones *within*, that were more eaſy to procure, in order to reduce the ſize of the moorſtone pieces, as much as would be conſiſtent with the intended

ſolidity

ſolidity of our work; that is, to ſtones from half a ton to a ton and half; but none to exceed two tons: and this appeared the more proper, as even to procure a ſufficient ſupply of thoſe, for the outſide only, it might be neceſſary to give orders at *all* the places I had viſited, at the ſame time.

The next morning, the 1ſt of May, being very moderate and the wind in our favour for returning, we weighed and went out to ſea; but found a conſiderable ſwell from the S. E. raiſed by the wind of the two preceding days; and before we came near the Edyſtone (where I propoſed to make a trial for landing if the weather ſhould ſuit) the wind had come to the S. W. and blew freſh, which by oppoſing the S. E. ſwell, raiſed it ſtill higher: wherefore we came that night into Cawſand Bay, and lay there to take the chance of the morning's tide; and be the more ready in caſe the weather ſhould be then in our favour; but it proving otherwiſe, we returned to Plymouth, where we landed on Sunday morning the 2d of May.

83. WHILE I was proſecuting my work at home, of laying down the meaſures of the rock upon paper, I was ſomewhat alarmed with a report which prevailed concerning a number of French prizes that had been brought into the harbour, laden with fiſh; which having laid there ſome time, were decaying and putrefying*. The report was, that by way of eaſily getting rid of them, it was intended to carry them out, and ſink them near the Edyſtone: however this I could not regard otherwiſe than as a falſe rumour; ſuppoſing that an idea of diſpoſing of them near *that place*, could never have been ſeriouſly adopted by any one in authority ſufficient to give that order.——Early in the morning of the 4th of May, the weather appearing favourable, we made our *Eighth* attempt to go out to the Edyſtone; and as I was going aboard our ſloop, advice was ſent to Mr. JESSOP by Mr. JOSEPH TOLCHER of the Cuſtom-houſe, that (being appointed to that ſervice) he was going to ſee the covers of the *Hatches* of forty of the fiſh ſhips above referred to, nailed down; and that they were intended to be carried out and ſunk at the Edyſtone. This in truth put me into a great conſternation; but being unwilling to loſe any opportunity of completing my meaſures upon the rock; and concluding that this purpoſe could not be ſo ſpeedily executed as to prevent my having an opportunity of ſpeaking with the officer deputed to carry them out, I determined to proceed in my voyage; but we had not got abreaſt of the Ram-Head, before a violent ſquall of wind and rain obliged us to return.——I immediately waited on Commiſſioner ROGERS to learn the truth of the above-mentioned report; who ſo far confirmed it, that he ſaid they were to be ſunk ſomewhere in the *Neighbourhood* of the Edyſtone: whereupon I told him, that it was ſufficient to undertake to make a building that ſhould be able to withſtand the utmoſt violence of the ſea: but it was too much to aid that powerful enemy with a *thouſand battering Rams*, which theſe ſhips might be expected to prove, when broken to pieces by ſucceſſive ſtorms, and driven againſt the works of the building. Being aſked how far from the Edyſtone it would be neceſſary to carry them; I told him it would not be ſafe at any moderate diſtance Eaſt or Weſt, leſt the flux and reflux of the tide ſhould bring the wreck upon the rock; nor nearer than three leagues to the South. With this he promiſed to acquaint Admiral MOSTYN who then commanded at Plymouth, and to return me an anſwer the next day: but as conſequences of this kind ſeemed to have a tendency ſo dangerous and miſchievous as to render the omiſſion of any means I could take to prevent it, inexcuſable; eſpecially as they might be more eaſily foreſeen than remedied, if the ſtep was actually taken; I therefore wrote the ſame day to one of the Proprietors, who upon the receipt of my letter, applied to the Lords of the ADMIRALTY, to ſend orders for theſe ſhips to be ſunk in ſome place at a greater diſtance from the rock than ſeemed intended: however, the day following I ſaw the *Admiral*, who politely aſſured me, that nothing ſhould be done, that could any way obſtruct the building of the Edyſtone Lighthouſe, and that there was *no ſuch* thing intended.

84. AS the weather continued unpromiſing till the 11th of May, I not only compleated my rough plan of the rock as far as my meaſures had gone, but put together my thoughts, upon the ſubject of facilitating the landing, as alſo upon the proper mode of carrying on the works upon the rock with *Expedition* and at the *leaſt poſſible Expence*, and communicated them by letter to the Proprietors.

* It may be a neceſſary explanation at this time to ſay, that theſe were veſſels that had been ſeized from the *French* before a formal declaration of war.

On

On diſcourſing again with Mr. JESSOP upon the ſubject of amending the landing at the Edyſtone, he informed me of an expedient they had ſometimes made uſe of; which was, that when a veſſel could not get into the Gut, ſo as to lie along-ſide the houſe when workmen were there for repairs, but yet could get ſo near, as to be out of danger, the weather admitting a barrel or log of wood with a rope faſtened to it to be thrown from the rock; they took this up into the veſſel or boat, and faſtening timbers thereto they were ſucceſſively hauled through the ſea, and ſo got upon the rock. This had frequently been done, and though it did ſometimes miſcarry, and always took up time, yet it was the beſt method they had been able to deviſe; and the only one they had ever practiſed: but this expedient would little avail me, as a ſtone building appeared by every day's reflection, and the experience of every voyage, more and more feaſible, as well as deſirable; and as my propoſed materials would not ſwim, a ſafe landing became a ſtill more important object.

Mr. JESSOP was in truth the only perſon I had met with, who ſeemed to have a competent knowledge of the ſituation of the rocks; and though very careful and accurate in finiſhing what he undertook, yet he was not a man of much invention. He had however a very clear and ſound judgment in whatever his practice and experience had put him into the way of knowing; and though apparent difficulties ſeemed to have kept his inventive faculties in awe; yet from his long experience, he generally proved an able adviſer concerning the operations propoſed to be performed at the Edyſtone.——As I looked upon a tolerably ſafe way to get to and from the building, and to lie there, particularly if it was to be of ſtone, as almoſt a *ſine quâ non*; and had on this occaſion fully communicated and explained my ideas to Mr. JESSOP and received his approbation, I took the firſt opportunity afterwards of acquainting the Proprietors therewith by letter, in nearly the following terms.

" I ſhall now deſcribe the manner in which I propoſe not only to facilitate the landing upon the rock, but to increaſe the ſafety of veſſels lying in the Gut.——The houſe-reef may in its natural poſition be conſidered as a pier, break-water, or bulwark to veſſels lying there; and this would have been very complete, had it not been for the following circumſtances. The rock that lies next to the northwards of that upon which the houſe is built, approaches nearly in height to that of its neighbour; and the top of it is about fifteen feet from the houſe rock*; but between thoſe two rocks is a low part, gully or hollow that is covered at about half tide, over which the ſea breaks, even in fine weather, at low water, when there is any thing of a ground ſwell; and the waves caſcade through this gap, into the Gut, as if, for the moment, an hundred mills were at work; which, when this takes place, not only endangers the filling of the boats, but raiſes ſuch a ſurge in the Gut, as to cauſe the veſſels to lie very unſteadily. This gap I propoſe to ſtop up, by firſt fixing an oak beam of at leaſt twelve inches ſcantling upon a level from the houſe rock, to the top of the north rock, very firmly with iron bolts at each end; which beam is to ſerve as a *Ridge-tree*, ſomewhat in the manner of that for the roof of a houſe. Then to bolt firmly down upon the ſloping ſurface of the rock below, two other timbers or ſills, one on each ſide the ridge, in ſuch manner, that three-inch planks being well ſpiked down upon the ridge-tree and upon the ſills on each ſide, ſhould form a figure like the roof of a houſe. The force of the ſea therefore, whichever way it comes, will be broken by running up the ſloping planking, and be prevented from running over in ſo large a quantity, whenever there is a probability of working upon the rock †.

" Moreover the eaſt ſide of the houſe rock, though pretty nearly upright, is remarkably ragged and indented; and particularly upon its moſt projecting parts‡, ſome of which conſiderably overhang; if therefore there is not a conſtant care to keep a boat from touching when lying alongſide the rock, her gunnel would be liable to be damaged by its aſperities; and by its being hooked under the projections, ſhe would be ſubject to be overſet even in the fineſt weather: and this inconvenience and hazard, not only

* See Plate N° 14.

† This part of the propoſition was never executed, principally for want of time at the proper ſeaſon when it was poſſible to have done it; but being ſatisfied of the practicability as well as utility thereof as a temporary expedient, if done, I give it here a place as appurtenant to the ſubject.

‡ See the ſouth views of the rock in Plates N° 6, 9, and 14.

ariſes from the unſteadineſs that is occaſioned by the caſcading of the water through the gully before mentioned; but when there is a breeze eaſtwardly, though not ſufficient to occaſion the ſea to break upon the landing-place, or prevent working; yet by the boats being driven againſt the rock, they would be ſubject to the diſaſters above deſcribed: and what is more material than what I have already mentioned, if the workmen ſhould be caught with a freſh of wind at Eaſt, the boats would be liable to be ſtaved, whilſt the men were getting themſelves and tools on board."——I had already found by my own experience, that ſuch kind of diſaſters we were ſubject to, and that we ſhould be ſtill much more liable to them in the courſe of the erection: and for an evil ſo great, the more ſimple the means, the better ſhould the contrivance be eſteemed by which it might be averted. To this end " I propoſe to fix timbers by bolts, upon the moſt prominent or projecting parts of the rock, in the manner of piles againſt the face of a quay, and at ſuch diſtances as to be nearer together than the length of our boats; by which means their gunnels and ſides being made to ſlide up and down againſt the piles, inſtead of the rock, there would be no danger of catching; and therefore a greater degree of ſecurity would take place, as well as that leſs care and attention would by that means become neceſſary *."

85. WHATEVER advantages might ultimately reſult to the public, from having a durable ſtone building in lieu of a periſhable wooden one, yet if the time that was neceſſary to be taken up in the erection, was likely to be greater than had been taken up by former builders, which was four ſummers, this would be a very ſenſible and ſtriking objection to my propoſition; and as the execution thereof would naturally require a greater time, in proportion to the whole additional tonnage of materials; this led me to every conſideration that had a natural or artificial tendency to expedite the work.——I found that the cuſtomary payment of ſuch artificers as had gone out upon the repairs of the late building, was five ſhillings per day, (or 35 ſhillings per week) from the time they held themſelves ready to put their foot into the veſſel to go out, to the time they were re-landed and diſcharged; without having any regard to the time employed in actual execution: what were the wages during the former buildings being *in hand*, I never could learn: but as there always had been, ſo long as memory reached, a houſe to receive and lodge the workmen, when they once got thither, the diſappointments attending the difficulty of landing and fruitleſs voyages were, under that circumſtance, of leſs conſequence: I was therefore ſolicitous to form ſuch a ſcheme for carrying on the works, as ſhould make the ſervice full as eligible to the workmen as formerly, at the ſame time that it ſhould be their *intereſt* to exert themſelves to the utmoſt; or at leaſt to ſpend as much time upon the *Rock* as poſſible; and alſo, that they ſhould be enabled to bear their labour chearfully during their continuance there, by not being ſubjected to any unreaſonable degree of fatigue, by long periods of ſervice. In conſequence of all this, the work would of courſe be performed, not only as expeditiouſly as poſſible, but at an expence to the Proprietors, as low, in regard to the value of day labour, as could poſſibly be expected upon the former eſtabliſhment.

It therefore ſeemed to me to be neceſſary, not only to moor a ſtore-veſſel in the neighbourhood of the rocks during the working ſeaſon, but to employ *two* complete ſets of hands for the outwork, to relieve each other in turns; ſo that whenever weather and tides would permit, the work might be purſued day and night.——That the workmen ſhould on no occaſion fall ſhort of the common wages of the country for their ſupport at ſea, whether circumſtances favoured or not; but that their making *extra Wages* ſhould depend upon the time they actually ſpent upon the rock; where in general, a reaſonable degree of employment could ſcarcely be avoided: and that it might be as much the intereſt of the ſeamen to uſe their beſt endeavours to get the workmen landed, and to encourage them to ſtay as long as they could, without imminent danger; their payment, as well as that of the foremen of each company, ſhould all follow the ſame kind of proportion.——Upon theſe ideas I drew up and tranſmitted to the Proprietors, the following plan for carrying on the works; and which in effect, with very little variation, was afterwards carried into execution.

* Thoſe timbers or piles with *Trenails* through them, to anſwer the purpoſe of a ladder, are repreſented at P. Q. Plate N° 14.

PLAN

PLAN *for carrying on the* WORKS *and Management of the* WORKMEN.

1ſt, That the Edyſtone ſervice ſhould by all reaſonable inducements be rendered preferable to any other common employment.

2d, That therefore (as a *puniſhment)* any one failing in his duty ſhould be immediately diſcharged.

3d, That the workmen ſhould be divided into *two* companies; one company to be out at the Rock, the other to be employed in the work-yard on ſhore.

4th, That every Saturday, the weather permitting, theſe two companies to change places; but the out-company not to return home till the in-company is carried out to relieve them.

5th, Every man to have certain fixed wages weekly; and the ſame whether *out* or *in.*

6th, Every man to receive —— per hour over and above the fixed wages, for every hour he works upon the rock.

7th, Every out-man to take all opportunities of landing upon the rock to work, when the weather ſerves, whether night or day, Sundays or work-days.

8th, The in-company not to work either nights or on Sundays, except in caſe of neceſſity, and then

9th, All *extra* work on ſhore to be paid for in proportion to double the *fixed* wages for the like time.

10th, The ſeamen to be alſo at conſtant weekly wages, with an addition of a fee certain and proportionable every tide's work upon the rock.

11th, Each company to have a foreman conſtantly with them while working upon the Rock; to be paid more than the common workmen, and in the ſame proportion.

12th, The engineer and his deputy, to go off alternately week for week; and each week to go off as often, and ſtay as long as weather will permit, or the ſervice require.

13th, In caſe of ſickneſs, or neceſſary abſence of either the engineer or deputy, the whole (if poſſible) to be taken care of by the other.

14th, All perſons to victual themſelves, but a bowl of punch to be allowed each company on their return on ſhore.

15th, The foremen, workmen and ſeamen, to be paid every time the reſpective companies return on ſhore.

16th, All work tools to be provided and repaired at the charge of the Proprietors, and to have a mark put upon each of them peculiar to the Edyſtone.

17th, Every perſon hurt or maimed in the out-ſervice to receive his common wages while under the ſurgeon's hands; and the Proprietors to pay the ſurgeon. This to be allowed on the certificate of the engineer, deputy and agent.

18th, Any perſon deſirous of quitting the ſervice, to give a week's notice to the engineer or deputy.

19th, The foreman on ſhore to take an account of every thing received into, or ſent out of the work-yard; as alſo of the day's works of the company, &c, with him; under the check of the engineer or his deputy when on ſhore.

20th, All ſmith's and plumber's work to be ſeen weighed by the foreman, engineer or deputy on ſhore; and all timber or wood work to be meaſured, and other materials taken account of by the ſame on receiving them.

21ſt, The foreman *afloat* to take account of time and landings upon the rock, to be chequed by the engineer or his deputy when afloat.

22d, An account of all matters done on ſhore to be given in weekly to the agent or accountant; and of all things done afloat by the proper foreman at the time of landing.

The further conſideration of theſe and many other matters, I referred to an interview with the Proprietors, to whom I was now in hopes of ſoon returning.

86. IN the afternoon of the 11th of May, we ſet out on our *Ninth* voyage, and got to the Rock in the evening; when we found the ſea ſufficiently quiet about it, to admit our landing; but it being near

near dark, and blowing freſh at N N. W. Mr. JESSOP and the ſeamen thought it not ſafe to go into the Gut that night, being of opinion that if the wind ſhould a little increaſe, or get nearer to the North, we ſhould not be able to get *out* again *.

On this occaſion the idea firſt occurred to me, that there might be a poſſibility of the water's being ſufficiently quiet for the boat to lie alongſide the rock (which uſed to be the criterion of the men being able to work thereon) and yet that the entrance or exit from the Gut might be impracticable or dangerous: this ſtruck me with a moſt ſenſible chagrin, inſomuch that I ſcarcely ſlept that night; partly with mortification at our preſent diſappointment, and partly in contriving means how to remedy ſo great an inconvenience: for the plan I had before laid down for the greater protection and ſecurity of the craft when lying in the Gut, would not have availed us in ſuch winds and tides as were now our obſtruction; and my ſcheme would ſtill be imperfect, if after I had made the lying there leſs dangerous, I ſhould not be able to reach it, or get out when there preſſed with danger.

The blowing up of the *Sugar-Loaf* rock was undoubtedly the firſt thing that occurred; but this in fact would only be a partial remedy. To level the Sugar-Loaf to its baſe, would of itſelf be a ſerious work; as it never could be ſet upon except when the ſea was remarkably ſtill and quiet; and would of courſe take up that time which would be the moſt valuable towards getting the houſe-rock cut for the proper reception of a ſtone foundation; and of conſequence prove a conſiderable hindrance to the execution of the main deſign: nor could this matter be expedited by an *additional* number of hands for that ſervice; becauſe as they could very rarely be applied, the incumbrance ariſing from a greater number of men afloat, than the main ſervice naturally required, would prove a real obſtruction to the general progreſs of the work: beſides if the Sugar-Loaf was in fact levelled with its baſe, yet as the Gut would remain barred up within a ſmall matter of low water, by flat rocks, which extend almoſt acroſs it in that place; to get a clear paſſage to the South, with a ſufficiency of water for the craft at low water, notwithſtanding it preſented itſelf as far from impoſſible, yet ſeemed likely to prove a greater work than that of the Light-houſe itſelf; and conſequently not to be thought of at this time.

Having obſerved the uſe that was made of *Tranſport Buoys*, in the moving and mooring the king's ſhips in the *Hamoaze*; it ſtruck me, that if a tranſport buoy of a ſize proportioned to our ſort of craft and ſervice, was moored with chains at the diſtance of about fifty fathoms directly North from the Gut, to which one end of a ſuitable cable or hawſer ſhould be *bent* (that is, faſtened) and the other carried to the landing-place in the Gut; and to prevent its being fretted againſt the rocks, ſo much of it as would be liable to touch, to be a chain; this cable and chain being kept always in repair, during the working ſeaſon, as there was nothing to hinder us from ſailing to this buoy, when veſſels could keep the ſea, they might lie there till it was a proper time of tide to go into the Gut: and then by means of this communicating cable, we ſhould be able to hawl them into and out of the Gut againſt wind and tide; and for facilitating of this with a few hands, I propoſed a windlaſs of a *new Contrivance* † to be put on board each of our larger veſſels that were to go into the Gut. Our buoy would alſo be attended with this further advantage, that in going out, the veſſel having gained it, her ſails might be ſet before ſhe quitted it; by which means ſhe would get under way, and ſhoot clear of the rocks when the wind blew northerly.

In the morning I communicated this propoſition to Mr. JESSOP, who thoroughly approved of it; and added, that if a couple of *eye-bolts*, at a competent diſtance North and South of each other, were fixed into the rocks on the *Eaſt* ſide of the Gut, to which ropes might be occaſionally faſtened, theſe would keep the boats from ſtriking againſt the houſe-rock, when the wind was eaſterly; and ſuch a contrivance would have been particularly uſeful the very laſt time we went out of the Gut.

87. THE 12th of *May* we landed on the rock at ſeven in the morning, and ſtaid till eleven, the wind being at S. S. W. It having been moderate during the night, the boat lay very quiet; but we at

* It has already been explained, that there is no paſſage to the ſouthward, through the Gut, on account of the *Sugar-Loaf* rock.

† This was by means of *Wheel and Pinion*, ſcarce heard of for ſuch a purpoſe at that time.

laſt

laſt found it adviſable to quit it, but more on account of the rain than the wind, (though that was becoming more freſh) as we were wet quite through, and what was worſe our papers were wet alſo: however having now taken all the moſt material meaſures, this circumſtance reconciled me to every thing elſe.—— At weighing to come home, our anchor having got foul of the rocks, we parted our cable, and afterwards in endeavouring to weigh the anchor by the buoy rope, we parted that alſo: ſo that we were obliged to leave the anchor behind us; the riſque of which would have been prevented, had we now had a tranſport buoy, ſuch as that propoſed.

88. AS it was my wiſh entirely to complete my meaſures, if a favourable opportunity happened, without further loſs of time; while I was preparing for my departure on the morning of the 15th of *May*, the weather again appeared favourable, and we proceeded on our *Tenth* voyage. We landed on the rock at half paſt eleven in the morning, and ſtaid there till half paſt two in the afternoon. The wind being then Eaſterly and beginning to blow a little freſh, we found it proper to quit the place for fear of ſtaving our veſſel againſt the houſe rock, of which there would have been much leſs danger, as ſhe would have been far more manageable, had the propoſed *fender* piles, or Mr. JESSOP's propoſition, been in uſe: for though we were ſix hands in the Edyſtone boat, and uſed our utmoſt endeavours to prevent it; in coming out of the Gut the boat ſtruck againſt the north rock, and ſprung a leak, though no conſiderable damage was done to her. Having now completed all the obſervations I was deſirous of making, which I was the better enabled to do, as it was a low ſpring ebb, I took my leave of the rock for the preſent with great ſatisfaction, and arrived at Plymouth that afternoon.

CHAP. III.

Containing Tranſactions and Occurrences during my Return from PLYMOUTH *to* LONDON *in May* 1756.

89. IN my return to London, I thought it neceſſary to take a view of the ſeveral places that had been pointed out to me, from whence *freeſtone* could be ſhipped for *Plymouth*; not ſo much indeed to acquaint myſelf with the nature of the ſtone itſelf, of which I had ſeen ſamples before; as to learn whether I could have the quantities worked upon the ſpot of ſuch weight, dimenſions and forms as I concluded would be needful; and to inform myſelf of the charge of freightage, and other particulars that I knew would be neceſſary to enable me to make any kind of eſtimate of the coſt of the building; which I muſt expect would be required from me by the Proprietors; or at leaſt that I ſhould give them all the information that I poſſibly could, touching ſuch things as related to the propoſed work.

90. WITH this view I firſt viſited the quarries at *Beare*, near the S. E. corner of *Devonſhire*, and near the ſea-coaſt. I found the bed or *Stratum* of freeſtone worked here, was of a conſiderable thickneſs; and with ſo great a cover of earth upon it, that it was worked in under-ground cavities; the ſuperincumbent *Strata* of earth, &c. being ſupported by pillars formed by detached parts of the *Stratum* left ſtanding. Here the ſtone, which is of the calcareous kind, and in point of hardneſs and texture much like the Bath ſtone, but whiter, lies in ſo ſolid and thick a bed, that blocks might be cut out from it of any ſize required: and though the *Stratum* is very compact (that is, free from fiſſures) yet it is of ſo ſoft and workable a nature, that I found the workmen ſawing out blocks from the general maſs (or *poſts*) with carpenter's ſaws, which they could do to any dimenſions required; and though this ſtone was capable of being thus wrought, and was ſo free to the tool, yet I found that it hardened conſiderably after being expoſed to the weather, as was manifeſt by the buildings that had been erected many

years at the village of *Beare*: the ſtone in the old buildings being in general covered with a kind of moſſy coating; and workmen, with reaſon, look upon the ſtone ſo coated, as not to be in a ſtate of waſte or decay. However, though hardened by time and weather, it yet ſeemed of a ſofter nature than I would wiſh for the conſtruction of a building, that in every ſtep of its erection would be ſubject to the extreme violence of the ſea.

91. MY next viſit was to the Iſle of *Portland*, at which place I had an addreſs to Mr. ROPER; who was the principal agent, or manager at the quarries for —— TUCKER, Eſq; of *Weymouth*, the principal quarry-proprietor or worker there.——I found Mr. ROPER a very plain, ſenſible, intelligent perſon; and as this iſle, as it is generally called, ſeemed to contain many things that awakened my curioſity, I was very glad to accept of him for my conductor or guide; and as being one of the principal reſidents upon the iſle, and particularly verſed in the works peculiar to it, no perſon could better have fulfilled my wiſhes.——Upon the commencement of the works of *Weſtminſter Bridge*, ſome time about the year 1739, Mr. ROPER was ſent down by the contracting maſon, as foreman, with a gang of maſons or ſtone-cutters from *London*; who were, according to moulds and drawings, to hew the ſtones upon the *place*, to ſave the freightage of the waſte: for, it is to be obſerved, that previous to this period, the ſtone ſent from Portland had always been ſhipped off in the rough, or rather what is called rough *ſcappelled* blocks; to be ſawn and fair wrought to the particular purpoſes, where wanted: and after the completion of that work, having engaged with Mr. TUCKER as ſuperintendant of his quarries, he had remained there ever ſince.

92. THE firſt thing that excited my curioſity, was the very ſubject I came upon, that is, the quarries from whence the ſtone ſent from Portland is produced.——The upper ſurface of the iſland I found was tolerably flat; but elevated above the ſea, according to the eſtimation of my eye, at leaſt 200 feet. The *Stratum* of ſtone that is wrought for ſale, lies nearly parallel with the upper ſurface of the iſland; and with not much cover of earth or rubbiſh upon it. There are ſeveral beds of ſtone lying in contiguity, one above another, varying in thickneſs in general from two to four feet and upward. Thoſe which are uſually called the *merchantable Beds* (on account of the blocks for ſale being produced therefrom) are univerſally covered with a *Stratum* called the *Cap*, which is formed entirely of a congeries of petrified ſea-ſhells, of a great variety of kinds, but in general ſo diſtinct and ſeparate in their forms, that to the curious naturaliſt, their ſpecies ſeem very eaſy to be made out*: but as they in a conſiderable degree retain their reſpective figures, (though in ſome places more, in ſome leſs) ſpaces or cavities are left between them, which conſequently very much diminiſh the coherence of the maſs; but yet the cementing principle is ſo ſtrong, that the whole together is conſiderably harder than the merchantable beds: and indeed ſo hard, that to get rid of it as eaſily as poſſible, it is generally *blaſted off* with *Gunpowder*.——Were it not for theſe cavities, the cap ſtone would not readily be worked with tools; or at leaſt it would not be worth working at a place where there is ſo great plenty of ſtone of a better quality: but as it is neceſſary to remove it in the courſe of working the better kind of ſtone, though by far the greateſt proportion is blaſted into fragments, yet for the buildings on the iſland, the cap-ſtone is in general uſe, and alſo for the piers and quay walls of *Weymouth Harbour*; as alſo in the pier for ſhipping ſtone at Portland, blocks are uſed from the cap; and indeed upon the whole, were it not for the expence of freight (which is the ſame as upon thoſe of the beſt quality) for various rough purpoſes under water, &c. the cap would make quite as good and durable work, as the merchantable blocks.

When the merchantable beds are cleared of the cap, the quarry-men proceed to croſs-cut the large flats, which are laid bare, with wedges, in the way I have deſcribed as to the moorſtone; only the wedges are not ſo numerous, nor does Portland ſtone ſplit ſo evenly as the *Granite*: and frequently in the ſplitting, as well as other working of this ſtone, oyſter and other foſſil-ſhells are diſcovered in the ſolid ſubſtance of the merchantable ſtone.——The beds being thus cut into diſtinct lumps, the quarry-man with a tool called a *Kevel*, which is at one end a hammer, and at the other an axe, whoſe edge is ſo ſhort or narrow

* There are many ſhells of the ſpiral kind, called *Cornua Ammonis*, ſome very large; and I ſaw one which when cleared from all ſurrounding matter was two feet in diameter.

that

that it approaches towards the ſhape of a pick*, by a repetition of ſturdy blows ſoon reduces a piece of ſtone, by *his Eye*, to the largeſt ſquare figure which it will admit; and blocks are thus formed from half a ton, to ſix or eight tons weight; or upwards, if particularly beſpoke.

93. WHEN I viewed the ſimple conſtruction of their carriages, I could not but wonder upon being told, that ſuch a very plain piece of machinery, was all they had for getting the largeſt blocks down to the water-ſide; but when I ſaw the application, my wonder ceaſed.——I have already obſerved, that the plain, upon which the quarries are ſituated, is conſiderably elevated above the ſea. It is further to be obſerved, that though the greateſt part of the circumference of the iſle to ſeaward is bounded by cliffs almoſt perpendicular, yet on the North ſide towards the main land of *Dorſetſhire*, the deſcent is more moderate, though it is rather quick every where.——It did not indeed at once occur to me, that though it would require a very great power to draw large ſtones *againſt* Gravity, or *up-hill*; and even a conſiderable one to draw them upon the plain ground; yet in moving *down-hill* their gravity would aſſiſt them.——The carriages are a kind of *Carts*, conſiſting of nothing more than a pair of very ſtrong ſolid low wheels (as well as I remember) about a yard in diameter, and a very thick axle-tree, upon which is fixed a ſtout planking or platform, that terminates in a draught-tree for ſteerage and yoking the cattle to.——The wheels and platform being low, the blocks are the more eaſily loaded thereon, and a neceſſary power is employed, according to the ſize of the block, to draw it to the commencement of the deſcent. ——To this place a quantity of blocks of different ſizes have been, at leiſure times previouſly drawn; and one of theſe blocks, of a ſuitable ſize, ſuch as experience has pointed out, is by a ſtrong chain attached to the carriage, on which the other block is placed, which is then drawn forward with the block in *tow*, till they are got ſufficiently upon the ſlope of the road, to find an inclination in the loaded carriage to move the attached block; after which all the horſes and beaſts of draught are taken off, except ſuch as are abſolutely neceſſary for the guidance; and in this way (the deſcent being continual to the pier) two large ſtones are got down with a degree of eaſe and expedition, that would be almoſt impracticable with *one* alone, without more complicated machinery.

94. I FOUND I could have every thing here, that I could deſire in the freeſtone way; ſo far a rough ſcappelling went; and at a price ſo moderate when delivered on board, that the freight, even to Plymouth, would be a conſiderable part of the charge: but that in regard to *hewing*, after the work of *Weſtminſter Bridge* was over, the hands brought here on that occaſion were diſperſed; or the few which were left had engaged to work in the quarries: and that except for ſuch large undertakings as *Weſtminſter Bridge*, what could be ſaved in freight, would not compenſate the diſadvantage of employing ſeparate workmen at a diſtance: for, in regard to the internal works of the iſland, there was not enough of them to maintain ſtone-cutters; and though they had juſt built a new church, which I obſerved had been neatly worked, and chiefly from the cap-ſtone, yet I found that workmen had been brought into the iſland to perform it.

95. FROM the practicability of the road in the way before mentioned, and alſo from the circumſtance of there being there the quieteſt water, the pier for ſhipping the ſtones is on the north ſide, adjoining to *Weymouth Road*; ſo that the ſtone veſſels, if catched by a ſtorm while lying there for a freight, retreat into *Weymouth Harbour*.

I did not fail to viſit the Lighthouſes, built nearly on the higheſt part of the iſland; but as they are built upon the *dry Land*, and burnt coals, I found they contained nothing ſingular, or material to my preſent purpoſe.——The various *Strata*, of which this iſland appears to be compoſed, would furniſh ſpeculation to the curious naturaliſt; but which the purpoſe of my preſent viſit did not allow me time particularly to attend to: but what ſtruck me moſt with wonder and amazement was the *Portland Beach*, which, I could not enter the iſland in croſſing the ſalt-water creek from Weymouth, without remarking:

* The *Kevel* is a tool curiouſly formed for the purpoſe; the face of the hammer end not being flat, but hollowed according to the portion of the ſurface of a cylinder; this gives a keen edge to two of its oppoſite ſides, that are parallel to the handle; and by this means biting keenly upon the ſtone, brings off a *Spawl* or large ſhiver. The edge at the pick end is about half an inch in breadth.

and

and which perhaps renders it impoſſible to decide whether *Portland* is really and properly an *Iſland* or not*. This work of nature is an immenſe bank or mound, formed to appearance of round pebbles of promiſcuous ſizes, the generality not exceeding the ſize of a pullet's egg; which by the action of the ſea in beating them one againſt another (being of a very hard nature) are worn ſo ſmooth and round, that a man can ſcarcely walk upon them without ſinking to the ankles, or a horſe to his knees at every ſtep. In conſequence of the matter being ſo looſe, it forms a conſiderable ſlope, both towards the ſea and to landward. It proceeds from the N. W. corner of the iſle of Portland, and keeps ſomewhat near a N. W. direction till it approaches the ſhore, at (I think) ſcarcely a mile diſtance. Had it there actually joined the ſhore, and had the reſt of the beach been heaped upon the natural coaſt of *Dorſetſhire*, this conformation would not have been a matter altogether ſingular: but on aſcending the ſummit of the *Beach*, which is ſeveral feet above high-water mark, that I might have a more diſtinct view of it (which I was fully enabled to do by its being low water when I firſt landed upon it) I found, that not only the part from the place where I ſtood, to its junction with the iſland, made a portion of a regular *curve*; but that it was continued in a *fair Sweep* as far as the eye could trace it, nearly parallel to the general range of the natural ſhore, but without joining it; and in this way I was told it proceeded almoſt to *Abbotſbury*, at the diſtance of 14 miles, and there united with the ſhore; ſo that a perſon chuſing to travel upon it from *Abbotſbury*, might with much labour and patience go to *Portland* on dry land even at high water.

A work of nature ſo regular in its form, muſt neceſſarily have a regular cauſe; what this cauſe may be, ſeems not very obvious, but it certainly is well worthy the attention of the ſkilful naturaliſt.——It would ſeem not to have had its origin at a very remote period; for the irregularities that the ſea had waſhed in the ancient coaſt were ſtill very diſtinct upon the ſalt-water creek (which as I have already ſaid, every where runs behind it, till its final junction with the ſhore,) whereas in any great length of time, they muſt have been ſo far acted upon by froſt, rain and wind, as to have been obliterated; ſince the preſent beach, like an immenſe bulwark, defends them from the immediate action of the ſea's making any further incroachments.——It would ſeem alſo, that this beach was formed ſomewhat ſuddenly; ſo as to be, as it were, at *once* a defence to the ancient coaſt: for had a quantity of pebbles been waſhed up from the ſea, and brought to the ſhore *gradually*, there does not appear to be any reaſon why the action that brought them thus far, ſhould drop them *ſhort* of the ſhore, and not heap them upon it; in which caſe, no ſalt-water creek would have been formed; for then the little irregular bays in the ſhore would have been firſt filled up, and the whole maſs brought forward in the ſame kind of fair curve, as we now find it: but from whence ſuch a maſs of pebbles ſhould come, as very ſoon to form ſo great a *Barricade* as to ſhut out the ſea, is a problem not ſeeming to admit of an eaſy ſolution†.

It further appears, that this beach lying in ſuch a direction as to receive the full action of the S. W. ſeas, the component pebbles are of ſo looſe a nature, that every tide makes an apparent change in the manner of its ſlope to ſeaward; which being formed into a ſort of ſteps, or benches, anſwerable to the laſt high-water mark, theſe range regularly for a conſiderable length, and ſeldom remain the ſame for ſeveral tides together.——In time of ſtorms, great quantities of the pebbles are driven over the ſummit, and as there is no power acting in a contrary direction, to bring them back again, one might at firſt be led to ſuppoſe the whole beach to be in a ſlow ſtate of progreſſion towards the ſhore, and that in time it would fill up the ſalt creek: but in contradiction to this idea, I was told, that four, five, or ſix feet beneath the ſurface of the pebbles, there is every where a ſtrong mound of *blue Clay*, having the ſame general ſhape as

* If an *Iſland*, with *Dr. Johnſon*, is defined to be a *Tract of Land ſurrounded with Water*, then this certainly is not an iſland; but if it be defined to be a tract of land, whoſe component *Strata* are altogether detached from the main land, in this ſenſe it may juſtly be denominated an iſland.

† On conſulting CAMDEN's *Britannia* 8vo edit. 1590, it would ſeem, that in his time this Beach muſt have been of far leſs bulk than at preſent; as he ſpeaks of its being cut aſunder by the action of particular winds, and its being conſolidated by others: and that Portland was formerly an iſland, though now annexed to the continent. His words are, ſpeaking of this beach, "*Flexuoſo hinc meatu longe ſe emittit iſthmus, aggerque* CHESIL *dictus ex arenis agglomeratis, freto tenui interfuſo per* IX. *mill. paſſ. obductus prætenditur, quem auſter cum ingruit, plerumque interſcindit, et aquilo e contra, conſolidat. Hoc aggere* PORTLAND *quondam inſula, nunc continenti adnectitur.*" Camb. Brit. page 14. *N. B.* The firſt Edition of CAMDEN was in the year 1586.

the beach. This one can hardly imagine to be in a moving ſtate: and though there may be an endleſs ſucceſſion of pebbles conſtantly waſhing up from the ſea, to ſupply the place of thoſe waſhed over the ſummit; yet ſtill, why there is not a gradual incroachment upon the ſalt creek, does not readily appear. Was there any conſiderable diſcharge of land water by this creek, that would doubtleſs keep it clear, and the reflux of the ſalt water may ſomewhat tend to the ſame end; but yet its reflux ſeems far too languid to be ſufficient for the purpoſe.

96. THOUGH I found my curioſity ſtrongly excited by this ſingular and ſurpriſing work of nature, yet I had not time fully to ſatisfy myſelf as to facts; and as I have not ſince met with any adequate account of it, I am inclined to give a place to ſuch particulars as I could relate from my own obſervations; as my doing this may excite more able naturaliſts to examine minutely into the hiſtory of it, and it ſeems very well to deſerve a more particular inveſtigation.——As I was ſtruck with wonder at the conſtruction of the Portland beach, I could not be wholly inattentive to an anecdote which occurred here, reſpecting an equal ſingularity in the manners and cuſtoms of the Portland *Quarrymen:* for at that time thoſe of the *South Sea* iſlanders were entirely unknown to us; and as I do not find the ſyſtem of Portland has been touched upon by any of our travellers or *Touriſts*, my reader I truſt will not be diſpleaſed, if I give him a ſhort ſketch thereof in a note, as it occured upon the place *.

97. HAVING ſettled my buſineſs with Mr. ROPER; that the beſt way to get our ſtone rough ſcappelled, nearly to the ſhape I required, would be to ſend rough moulds, aſcertaining the figure, with the thickneſs of the courſe marked upon each mould, and each dimenſion to be one inch bigger than the true ſize previous to being fair worked, we ſhould not by this means have much extra *Weight*; as only the medium of half an inch on a ſide would be to cut off, and which would be ſufficient to form the true figure; I then took leave of him and this curious iſland: and though I had every reaſon to be ſatisfied both with the material and my correſpondent; yet nevertheleſs in my paſſage from thence to London, I determined not to leave any thing unſeen that might contribute to my information; and for that reaſon, to

* When I was looking over the quarries at Portland, and attentively conſidering the operations; obſerving how ſoon the quarrymen would cut half a ton of *Spawls* from an unformed block, and what large pieces flew off at every ſtroke; how ſpeedily their blows followed one another, and how inceſſantly they purſued this labour, with a tool of from 18 to 20 pounds weight; I was naturally led to view and conſider the figure of the *operative* Agent; and after having obſerved that by far the greateſt number of the quarrymen were of a very robuſt, hardy form, in whoſe hands the tool I have mentioned ſeemed a mere *Plaything*; I at laſt broke out with ſurprize, and enquired of my guide, Mr. ROPER, where they could poſſibly pick up ſuch a ſet of ſtout fellows to handle the *Kevel*, which in their hands ſeemed nothing: for I obſerved that in the ſpace of 15 minutes, they would knock off as much waſte matter from a maſs of ſtone, as any of that occupation I had ever ſeen before would do in an hour.——Says ROPER, we do not go to fetch thoſe men from a diſtance, they are all born upon the iſland, and many of them have never been further upon the main land than to *Weymouth*. I told him, I thought the air of that iſland muſt be very propitious, to furniſh a breed of men ſo particularly formed for the buſineſs they followed.—— The air, he replied, though very ſharp, from our elevated ſituation, is certainly very healthy to working men; yet if you knew how theſe men are produced, you would wonder the leſs; for *all* our marriages here are productive of children.——On deſiring an explanation how this happened, he proceeded: "Our people here, as they are bred to hard labour, are very early in a condition to marry and provide for a family; they intermarry with one another, very rarely going to the main land to ſeek a wife; and it has been the cuſtom of the iſland from time immemorial, that they never marry till the woman is pregnant." But pray, ſays I, does not this ſubject you to a great number of baſtards? Have not your *Portlanders* the ſame kind of fickleneſs in their attachments, that *Engliſhmen* are ſubject to? And in conſequence, does not this produce many inconveniencies? None at all, replies ROPER, "for previous to my arrival here, there was but one child, on record of the pariſh regiſter, that had been born a baſtard in the compaſs of 150 years. The mode of courtſhip here is, that a young woman never admits of the ſerious addreſſes of a young man, but on ſuppoſition of a thorough probation.——When ſhe becomes with child, ſhe tells her mother; the mother tells her father; her father tells his father, and he tells his ſon, that it is then proper time to be *married*."——But ſuppoſe, Mr. ROPER, ſhe does *not* prove to be with child, what happens then? do they live together without marriage? or, if they ſeparate, is not this ſuch an imputation upon her, as to prevent her getting another ſuitor? The caſe is thus managed, anſwered my friend: "If the woman does not prove with child, after a competent time of courtſhip, they conclude they are not deſtined by Providence for each other; they therefore ſeparate; and as it is an eſtabliſhed maxim, which the Portland women obſerve with great ſtrictneſs, never to admit a plurality of lovers at one time, their honour is no ways tarniſhed: ſhe juſt as ſoon (after the affair is declared to be broke off) gets another ſuitor, as if ſhe had been left a widow, or that nothing had ever happened, but that ſhe had remained an immaculate virgin."——But pray, Sir, did nothing particular happen upon your men coming down from London? Yes, ſays he, our men were much ſtruck and mightily pleaſed with the facility of the Portland ladies, and it was not long before ſeveral of the women proved with child: but the men being called upon to marry them, this part of the leſſon they were uninſtructed in; and on their refuſal, the Portland women aroſe to ſtone them out of the iſland, inſomuch that thoſe few who did not chuſe to take their ſweethearts for *better, or for worſe*, after ſo fair a trial, were in reality obliged to decamp: and on this occaſion ſome few baſtards were born: but ſince then matters have gone on according to the ancient cuſtom.

take a view of the ſtate of the quarries at *Purbeck*; from whence, for ages, *London* had been chiefly ſupplied with flat paving ſtones, and ſteps.

98. HAVING made my entry into the *Peninſula*, or, as it is generally called, the *Iſle* of Purbeck, by the ruins of *Corf Caſtle*; and obſerving that a conſiderable part of the out-wall was in a remarkably leaning condition, ſomething like the repreſentation of the leaning tower of *Piſa*; I ſtopped to examine the maſonry, and particularly the mortar, of a building that was capable of ſo great a degree of inclination without falling to pieces.——I found its ſolidity, as uſual in ancient buildings, did not conſiſt in having been built with large hewn ſtones throughout, for the interior filling of the walls was with rough *Rubble*, and fragments of the quarries; the interſtices being entirely filled up with mortar, that undoubtedly had originally been fluid, and in that ſtate poured in: and from the nature of the component matter, as well as time, the whole maſs had become ſtrongly cemented together. I found that the mortar was compoſed of lime (doubtleſs originally of a good quality) with a conſiderable admixture of ſharp ſand and *Pebbles*.

99. ON going to *Sandwich*, or, as commonly called, *Swanage*, the principal town of the quarrymen, and having procured a guide, I firſt went to view the quarries where the flat paving and ſteps were wrought. The *Strata* here are thin, ſome only of three inches, and ſeldom any ſingle layer above twelve inches; the whole of ſeveral contiguous beds, taken together, being at that time, not much above a yard and an half in thickneſs. Having a good deal of cover of earth, &c. upon them, they were then chiefly wrought underground; and the whole of the merchantable ſtone being taken out, the incumbent matter was ſupported by building rough pillars with ſtone of an inferior quality.

From obſerving the nature of the thicker layers of this ſtone, I was at firſt led to imagine that this was the place from whence that peculiar kind of marble had been obtained, of which thoſe long, ſlender, poliſhed columns are formed, that are to be met with in moſt of the old cathedrals, even at a great diſtance from *Purbeck*; and which at thoſe diſtant places are often taken for an artificial compoſition *.——I was ſhewn a diſtrict of ground where flat paving ſtone had been formerly wrought in *Strata* near the ſurface; ſo that it was then eaſily come at, and in great plenty; but the continual demand for the *London Market*, had in a great degree exhauſted the quarries ſo circumſtanced, and reduced the product chiefly to what they got underground in the manner I ſaw; ſo that the flat paving had already very conſiderably advanced in price, and was likely to advance ſtill much higher †.

100. FROM hence I was carried to ſee the quarries where a ſpecies of ſtone was got in blocks, much of the nature and colour of Portland, which is called *Purbeck-Portland*.——Theſe quarries are ſituated at, or near the point of high land, about three miles from Swanage, called St. *Alban's Head*. The ſtrata of merchantable ſtone lie here in the upper part of the cliffs, as they do at Portland; but having more cover, they are in ſome meaſure worked underground. This ſtone is of the like nature, and puts on ſo much the appearance of the Portland, that it is often uſed in lieu of it. It is however inferior in colour, harder to work, and according to the information I then got, not in general near ſo durable ‡. But what ſeemed to me likely for ever to prohibit this field of ſtone from coming into competition with

* That great naturaliſt Dr. WOODWARD, is however, it ſeems, of opinion, that thoſe ſlender columns extant in many of our cathedrals, are dug from the quarries of the ſame kind of ſtone at *Petworth* in *Suſſex*.

† About the year 1764 the *Calder Navigation* in *Yorkſhire*, having been opened, this gave water carriage to London of the immenſe beds of flat paving (there called *flags*) from the quarries of *Elland Edge* and *Cromwell Bottom*; by which means the ſchemes for new-paving the cities of *London* and *Weſtminſter* were carried into effectual execution. This is not a marble or calcareous ſtone, like the Purbeck, but is of the grit kind; yet of ſo cloſe and fine a grain, as to be equally ſtrong and durable, and, like moorſtone, much leſs ſlippery to the ſhoes when wet. I mean the kind really produced at the above quarries; for there is ſtone from other places, of the ſame appearance, furniſhed to the public under the ſame denomination, which is much inferior in hardneſs and durability.

‡ The ſtone properly called *Purbeck aſhler*, is of the ſame nature as the flat paving and ſteps, and ſufficiently durable for all purpoſes; but a great part of thoſe *Strata* are under twelve inches; yet ſome of them run to 18 and 20 inches thick, as I am *now* informed.

Portland

Portland, is; that as it cannot bear the expence of land-carriage down to *Swanage* to be ſhipped, the workmen are obliged to let it down with ropes from the place where it is wrought, to the ſurface of the ſea, either into veſſels lying at the foot of the cliffs where there is deep water, or where there is a dry *Strand* at low water; but there being little ſhelter from the winds and ſeas, this can only be done in very moderate weather, and particular winds; wherefore the ſhipping it there, muſt neceſſarily be ſomewhat precarious. For theſe reaſons, though for the interior works of the Edyſtone the quality ſeemed not objectionable, and the ſtone could be afforded at ſomewhat leſs price than Portland; yet from the uncertainty of ſhipping, being ſomewhat further from Plymouth, and few hands, comparatively ſpeaking, being employed here, to what were employed in the quarries of Portland*, it ſeemed a place much leſs capable of *expediting* my orders; and therefore, that Portland was to be preferred: expedition in getting the work forward being of ſo much greater conſequence to what I had in view, than any ſmall difference in the price.

Immediately on leaving the iſle of Purbeck, I purſued my journey to London, where I arrived on Friday the 21ſt of May; having taken no more than five days in performing the whole, including all obſervations; and nothing further occurred in it which I think worthy the obſervation of my reader.

CHAP. IV.

Containing Tranſactions in LONDON *after my Firſt Journey to* PLYMOUTH.

101. IMMEDIATELY on my return to London, I attended the Proprietors at a general meeting, and laid before them a full account of all my proceedings, and the information I had got in my late progreſs; together with my obſervations and thoughts relative thereto, which I have already particularized in the courſe of my narrative. The great and leading point now to be determined was, whether the houſe ſhould be rebuilt entirely with ſtone, or entirely with timber; or partly with one, and partly with the other.——One principal matter to be conſidered, was that of *Time*, upon which ſubject I was fully examined; and aſſured the gentlemen, as my mature opinion, that if the building was to be entirely of ſtone, there appeared to me every degree of probability of my being able, not only to complete it in the like ſpace of time, that the former Lighthouſes had taken, which was four ſeaſons; but, if required, to exhibit a light upon the building itſelf in the courſe of the third.——That upon the ſame reaſonable grounds, it ſeemed to be equally practicable to raiſe a building with a ſtone baſe, and a ſuperſtructure of wood, in three ſeaſons, and to build one of wood in the ſtyle and manner of Mr. RUDYERD (with ſome improvements) in two ſeaſons.——On being examined reſpecting *expence*, I obſerved to the Proprietors, that to make an eſtimate of a building in each of thoſe ways, was no difficult matter; ſo far as related to a certain given quantity of materials and the workmanſhip; but that, as in the progreſs of the work we ſhould lie ſo widely open to accidents, I could not undertake to make any calculation of this part, which might not poſſibly be exceeded *tenfold*; and conſequently could not make any eſtimate of what the whole expence of any ſtructure might amount to, in ſuch a ſituation as the Edyſtone. The whole therefore that I was enabled to ſay with any propriety was, that they being under the neceſſity of building the houſe in one of the three ways; whichever they choſe, it ſhould be my moſt earneſt endeavour, not only to perform the work in the moſt ſubſtantial manner, but at the leaſt poſſible expence, conſiſtent with the neceſſary degree of firmneſs to give a reaſonable expectation of durability.

* It ſhould ſeem from the printed account of the loſs of the *Halſewell Indiaman* in the month of January 1786, which happened in the neighbourhood of theſe quarries; that the aſſiſtance of ropes, &c. given to that very unfortunate crew, would indicate a greater number of quarrymen than would be inferred from the above account of mine; but it muſt be obſerved, that I am ſpeaking of this as they appeared to me above 30 years ago.

102. I MUST here obſerve to the honour of the Gentlemen concerned, that without debate, it was almoſt immediately determined to rebuild the houſe entirely with ſtone, and in the very beſt manner. ——The particular reaſon that induced the Proprietors to prefer that method, which undoubtedly would be the moſt expenſive to them, rather than either of thoſe which would be leſs ſo; as well as attended with leſs loſs of time, it is impoſſible for me to paſs over in ſilence.——It ſeemed very imprudent indeed, as far as their own intereſt only was concerned, that they ſhould think, in the ſituation they then were, of launching out into any expences beyond what was abſolutely neceſſary.——The building which had been lately deſtroyed, had, as already obſerved, ſtood near half a century, and had it not been deſtroyed by *Fire*, might, with proper attention, have exiſted much longer. A building therefore upon a ſimilar conſtruction, would moſt probably laſt for an equal length of time; or at leaſt as long as their preſent intereſt in the duties was to continue, and this would have been ſooner executed, and have coſt much leſs than one entirely of ſtone.——The Proprietors had alſo, with an equal ſpirit of generoſity, excluded themſelves from the reception of all profits, by voluntarily ſtopping the payment of the duties, till a light could be exhibited, as has been already taken notice of.——The Gentlemen were, indeed, ſufficiently ſenſible, that in all probability, the repairs of a ſtone building would be leſs frequent than thoſe of a wooden one; but yet, when neceſſary, might be much more chargeable, and even ſuppoſing they were not ſo, yet as a ſtone building would be much more expenſive, as well as hazardous in erecting, than any other, they would incur a *preſent certain* charge, to prevent a *future uncertain* one; ſo that it could not ſeem prudent, with reſpect to their own intereſt, to lay out 3 or 4,000 *l.* now, with the expectation of ſaving the like ſum in repairs 30 or 40 years afterwards. This therefore was not the ſort of conſideration that determined the Proprietors to erect a ſtone building; but their reſolution was in reality founded on motives wherein ſelf-intereſt did not bear any ſhare. They conſcientiouſly conſidered the intention of the legiſlature, in originally granting the duties, which they conceived were not given to the honourable corporation of TRINITY-HOUSE, and their *Aſſigns*, merely for their own emolument; but granted, through that channel, as the recompence to thoſe perſons, who at a great pecuniary riſque (beſides encountering other hazards) would procure ſuch a degree of ſecurity, as might be the means of ſaving from deſtruction, on this very dangerous rock, not only his Majeſty's fleets, but of preſerving the lives and properties of his trading ſubjects; and at the ſame time afford the like preſervation to the ſhipping of foreigners. This they conſidered as the ſole intention of the legiſlature, and that there might be no deficiency on their parts, in advancing ſo noble, ſo beneficial, and ſo humane a deſign, they determined that this preſervative of trade and navigation, ſhould be rendered as *durable* as *Nature and Art* could furniſh means for doing.——Nor was their public ſpirit confined to this object alone; for they had launched out into another hazardous and chargeable experiment, to ſupply the want of ſo uſeful an edifice, during the time that ſhould be taken up in building a new houſe, and preparing it for the exhibition of a light; and that was, by fitting out a veſſel for a *floating Light*: and though this was only conſidered as a temporary expedient, yet from the nature of the ſervice and ſituation in which it was to be employed, it was requiſite to make the experiment as valid and ſufficient, as if its exiſtence was intended to be of long continuance; and therefore of itſelf was a ſerious concern. This was actually going on at the very time of a new building's being determined upon as above; and had been a conſiderable time before, fitting out under the advice and direction of a committee, or of ſelect members, of the TRINITY-HOUSE: though till the 12th of May then laſt paſt, when the *Merchants* begun a ſubſcription, agreeing to pay the uſual duties, the Proprietors were uncertain, whether there would be a foundation, upon which they might be reimburſed a ſingle ſhilling.——Even by the proſpect which this ſubſcription opened, the Proprietors could not reaſonably expect to receive any great advantage by this undertaking; when the nature and hazard of it, as well as certain charge of the *Out-fit* was duly taken into conſideration: and with regard to the Lighthouſe itſelf, the very utmoſt benefit, that there was any probability might accrue to them, would greatly fall ſhort of reimburſing the difference of expence and time, between erecting a building like the former, and one entirely of ſtone.

Such were the proſpects of thoſe Gentlemen, and ſuch were their determinations at this time; in recording which, I have ſtrictly adhered to matter of fact. Was my pen capable of it, the *Theſis* would admit of great embelliſhment; however it luckily happens for me, that it does not need it: but the pen being

being in my hand, even after this long lapſe of time: after all accounts cloſed; all expectancies ended; and I may ſay, after all connection and almoſt all acquaintance diſſolved; it would yet be a violence to myſelf, to refrain from doing the Proprietors juſtice, ſo far as I have touched upon this head; by informing the world (that part of it eſpecially which is moſt nearly intereſted in navigation and commerce) to whom, and to what principles they owe the preſent ſtructure of the *Edyſtone Lighthouſe*.

104. THE materials of which the main body of this houſe was to be rebuilt, being now reſolved upon; as well as that its outward form ſhould as nearly reſemble that of the former one, as I ſhould find conſiſtent with the different nature of the chief material, and the improvements that offered themſelves; to prevent any unneceſſary delay in making *Eſtimates*, &c. the Gentlemen were pleaſed to content themſelves with ſuch general ideas of *expence* and *time* as my obſervations enabled me verbally to make: I was therefore deſired without loſs of time, to apply myſelf to making and providing ſuch models and deſigns, as ſhould enable me fully to explain my propoſition to themſelves, and afterwards to ſuch other bodies, as they ſhould think it right to conſult: at the ſame time informing me, that though they were ſenſible that the ſeaſon was near approaching in which ſomething *might be expected* to be *done* upon the rock; yet they had ſuch confidence in my judgment, that being now myſelf apprized of what was to be done, they left both the *Time* and the *Means* of its accompliſhment to me.

105. ON this occaſion I found myſelf totally unfettered; and perhaps no reſolution of the Proprietors ever more conduced to the ultimate ſucceſs of the work, than this, which ſet me ſo much at liberty. Had they been of the ſame temper and diſpoſition of by far the greateſt part of thoſe who have employed me, both before and ſince, their language would have been, *Get on, get on, for God's ſake, get on!* the public is in expectation, get us ſomething ſpeedily to ſhew, by which we may gain credit with the public! This, however, was not their tone, which I looked upon as a happy earneſt from the Proprietors in the outſet.

I conſidered, that though we ſhould have a great increaſe of tonnage of materials to carry out and fix, beyond what former undertakers had had, yet that the whole bulk and weight, even as the building was now to be executed, would *in reality* be no very great matter; and that, in the preſent circumſtance, the main object was to digeſt ſuch a ſcheme as ſhould go *progreſſively on as opportunity admitted*, without being ſubject to great derangements, or having the ſame thing to do twice over, on account of miſtake or failure of the parts. It was with this general idea of the matter, that I took ſo much pains, and ſpent ſo much time, in getting accurate dimenſions of the peculiarities of the rock, as I have already related; and this part of the work having taken a greater length of time than I expected; which aroſe from finding the rock more difficult of acceſs; and, from its irregularity, requiring a greater variety of dimenſions than I had imagined; yet as I had by perſeverance fully accompliſhed my wiſh in this reſpect; the labour ſo employed would have been of leſs value, unleſs made uſe of to its proper intention; which was, that of having an accurate reſemblance of the rock at *all Times* to recur to; in order that, the effect of any operation might, without going upon the rock itſelf, be judged of, ſo far as it depended upon the peculiarity of its form.——I further conſidered, that though I was now upon the verge of the proper ſeaſon for action; yet as we could not expect to carry out any materials, or do any thing more this year, than *cut the Rock* to ſuch a figure as ſhould ſuit the building; and as this figure could not be aſcertained, without fully conſidering and determining the form and dimenſions of the building itſelf, ſo as to ſhew the manner in which it was to apply to the rock; I could readily ſee that the time which would be ſpent in ſuch a mature digeſtion, would be much more than ſaved by avoiding unneceſſary and improper work, upon a body of ſo hard a texture as that we had to deal with.——Had it been practicable to have cut the rock down to the level of the loweſt part of the intended baſe of the building, little previous contrivance or conſideration, would have been wanted for the purpoſe: but beſides that this would have been more than the work of a full ſeaſon; the ſpace which had been previouſly occupied by the rock ſo cut down muſt have been made good by *freſh Matter*; and that could never be expected to be ſo perfectly firm and

 ſolid,

ſolid, as the unſhaken parts of the rock itſelf: and beſides, we ſhould then have loſt the rock as a *Hold-faſt*, and *Buttreſs* againſt the great South-weſt ſeas; which, ſo high as it reached, was of the moſt effectual kind poſſible.

It ſeeming therefore to be a firſt principle, to cut the rock as *little as we could help*; and for this end, to humour its irregularities as far as we could, ſo as to get a firm fixing for our work; on this account it appeared neceſſary, as the firſt ſtep to be taken (from the dimenſions already obtained, and by the methods already ſpecified) to conſtruct a *complete Model* of the rock, in the condition I found it: which being done, a ſecond model might *then* be formed, ſhewing to what the rock was to be reduced, with the manner of applying the work of the building thereto; and ſo as to deſcribe the external general form, which would be the whole of what was then wanted, for preſent determination; and for adjuſting the work of the approaching ſeaſon. Theſe models I determined ſhould be the work of *my own hands*; and this I foreſaw, muſt in its own nature be a work of *Time*.

106. THOSE of my readers, who are not in the practice of handling mechanical tools themſelves, but are under the neceſſity of applying to the manual operations of others, will undoubtedly conclude, that I might have ſaved much time, by employing the hands of others in this matter: and on the idea of the deſign being already fixed, and fully and accurately, as well as diſtinctly made out; that is, ſuppoſing the *thing done*, that was *wanted* to be done, it certainly would have been ſo: and had I wanted a duplicate of any part, or of the whole, when done, I ſhould certainly have had recourſe to the hands of others. But ſuch of my readers, as are in the uſe of handling tools, for the purpoſe of contrivance and invention, will clearly ſee, that provided I could work with as much facility and diſpatch as thoſe I might happen to meet with and employ, I ſhould ſave all the time and difficulty, and often the vexation, miſtakes and diſappointments that ariſe from a communication of one's own ideas to others; and that when ſteps of invention are to follow one another in ſucceſſion, and dependance on what preceded, under ſuch circumſtances, it is not eligible to make uſe of the hands of others.

I had alſo a further reaſon for undertaking this part of the work myſelf; which thoſe who ſhall peruſe this account for the ſake of information, may not be diſpleaſed to know.—— I have always found in ſubjects of mechanical invention and inveſtigation, that I can ſeldom form an original idea ſo complete, but that by laying it down in its proper dimenſions on paper, I could very much mature and improve it; and where the ſubject is attended with intricacy, it is in a greater degree neceſſary: but in reducing this to a *ſolid*, as is the caſe in making a model, ſtill further corrections and advantages will often preſent themſelves, that did not appear upon *Paper*: and this in a much more eminent degree when the *ſolid* is produced from the drawing by the artiſt's *own* hand, than by the hand of another: and ſtill further improvements will occur, by going again over the *detail*, in conſtructing the work itſelf at large. Therefore to avail myſelf of all poſſible advantages of previous light and information, I determined, from the paper materials that I had brought from Plymouth; as well as thoſe I carried thither; at once to conſtruct the models above-mentioned myſelf; in which work, though I was cloſely engaged till the month of July; there was no impatience on the part of the Proprietors; as Mr. WESTON viſited me almoſt daily, and was himſelf witneſs of the progreſs.——It may here be proper to ſay, that though I thought it neceſſary to employ my own hands upon the models, yet I availed myſelf of thoſe of others, wherever I found them applicable: for having conſidered that I could not avoid having occaſion for at leaſt one great *Purchaſe-Tackle*; I therefore gave out a deſign to a proper workman, to execute a pair of tackle-blocks, in the ſtyle and manner of thoſe I had publiſhed the uſe and figure of in the *Philoſophical Tranſactions*, Vol. 47, for the years 1752 and 1753; only that inſtead of iron or metal plates for forming compartments for the *Sheaves* or pullies, theſe were conſtructed with boards for the ſake of lightneſs, and avoiding corroſion by the ſalt-water. Plate N° 18. contains the deſign of theſe blocks *.

* By afterwards employing the late Mr. DUNSTERVILLE, an ingenious blockmaker at *Plymouth*, upon works of the like nature; a ſpecies of new manufacture of ſhip's blocks has ariſen, now, and for a number of years paſt carried on by the preſent Mr. DUNSTERVILLE at *Plymouth*, and Mr. TAYLOR at *Southampton*.——The term *Purchaſe Tackle* has of late years been applied to this kind of blocks.

107. IN

107. IN this interval, however, I took a day with the above-mentioned Gentleman to viſit the veſſel then fitting out in the river, for the purpoſe of the *floating Light*; and to do this, beſides the natural impulſe of curioſity, I was deſirous of ſeeing how far its equipment might ſuit the purpoſes of a *Store-Veſſel* for our building ſervice.——This veſſel was called the *Neptune Buſs*, having been purchaſed for this ſervice from a great number of buſſes, that had been fitted out for the *Herring Fiſhery*, as a *National Concern*; which project having then failed, the veſſels were ſold. The *Neptune* was picked out as being remarkably well *found* and roomy, and her burthen, as I recollect, when thus fitted, was about 80 tons.——For this intended ſervice, ſhe had been heightened four *Streakes*; her deck raiſed, and laid fluſh *fore* and *aft*; ſo that if a ſea was to break upon her, there would be no lodgment for the water; nor any where for it to enter the veſſel, if the hatchways were ſhut; and thoſe were not ſpacious: and furthermore in caſe this veſſel was to touch upon the rocks, ſhe would not *ſink*, unleſs broken to pieces; being ſo far ballaſted and loaded with fir timber, that though there ſhould happen to be free admiſſion of the water through the bottom, ſhe ſtill would be *Buoyant*, even with her neceſſary ſtores on board. This I thought an admirable contrivance for ſafety in ſuch a ſervice; and though the timber took up a good deal of room, yet in ſo large a veſſel, there ſeemed to me a probability of there being room enough, both for the lightkeepers, and ſuch of the Edyſtone workmen as muſt in their weekly rotations neceſſarily remain there. I alſo found her fitted out with an excellent *Windlaſs*, and was told, that large mooring chains were preparing: and in every reſpect, as far as my judgment could carry me, ſhe was exceedingly well calculated for the ſervice intended, and likely to do credit to the Gentlemen who had taken the direction of her works *.

On this occaſion I obſerved to my worthy employer, Mr. WESTON, that it was probable the fitting out of this Buſs, would be a ſaving of at leaſt 4 or 500 *l.* in the equipment of a ſtore-veſſel, as I had formerly hinted, in caſe the corporation of TRINITY-HOUSE ſhould think proper to order the Neptune to be moored within a moderate diſtance from the rocks, any where to the N. or N. Weſtward of them; and as this might ſerve both the purpoſes, it would greatly relieve the heavy expence they were likely to be at, not only in the floating light, but the ſtone building.——To this he anſwered, that as the primary intention of a *floating Light*, was the preſervation of trade and navigation only; and as the corporation of TRINITY HOUSE, moſt of whom were bred to the ſea, had all along given their advice and aſſiſtance in the fitting out of this veſſel; ſo it was preſumed they were the proper judges, *where* it ought to be moored to anſwer the end beſt; and that for his part in particular, though he had preſumed to ſuggeſt a hint to their more mature conſideration, yet he by no means wiſhed to bias their judgments, from an attention to the public welfare, by any reaſons which might appear to be blended with a principle of ſelf-intereſt. ——However, though thus fully anſwered, as I was ſure it would be no very material impediment to the works, I was determined not to be precipitate in purchaſing, or agreeing for a proper ſtore-veſſel, till I ſhould know for a certainty, where the floating light was intended to be moored; and by that means give the Proprietors a chance of ſaving 500 *l.* which I judged might be about the ſum which a ſtore-veſſel fitted ſeparately for our uſe would coſt.——Upon the 8th of July I was informed that the buſs with all her men, tackle, and furniture, ſailed down the river for Plymouth, but the account of her arrival there (which was on the 17th of the ſame month) was not returned, while I ſtaid in town.

108. MY models and preparatory matters were now ſo far brought forward, that Tueſday the 13th of July was appointed by the Proprietors for receiving my explanation of what I had to lay before them. I accordingly attended, and ſubmitted to their inſpection a complete model of the *houſe-rock*, in the ſtate in which I had found it; and repreſenting all the iron branches broken and whole, of which model, Plate N° 7. contains a reduced plan and elevation: and this was accompanied with another model of the ſame rock, cut to the intended ſhape for receiving the building; and therewith connected, a model of the building itſelf; ſhewing diſtinctly how the work was to be adapted to each ſeparate ſtep in the aſcent of

* Thoſe deſcriptions and anecdotes concerning the *Neptune Buſs*, I ſhould have entirely omitted, as being themſelves of little conſequence *now*; had it not happened to me afterwards, to have even more connexion with her than I then expected; and as this will ſave ſo much explanation and deſcription hereafter, I therefore give this part of it in the order of time.

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the rock, as high as I propoſed to continue it; and particularly exhibiting the conſtruction of the firſt entire courſe, after riſing to the level of the upper ſurface of the rock; to which a ſolid being fitted, this model ſhewed the external form of the whole building, including the lantern; and by a complete ſection of this on paper, to the ſame ſcale, the rooms and conveniencies on the inſide were fully expreſſed: and I muſt beg leave on this occaſion to obſerve, that it was by now working in the ſolid, in forming the model for the building, I perceived that for the ſecurity of the ground joint, which would be ſubject to a ſuperior action of the ſea, to any other (as lying in the internal angle) it would be neceſſary, not only that the bed of every ſtone ſhould have a level bearing; but that every outſide piece ſhould be grafted into the rock, ſo as to be guarded by a border thereof, at leaſt three inches in height before it; which would in reality be equivalent to the founding of the building in a *ſocket* of three inches deep in the ſhalloweſt part.

109. THE whole having been now fully conſidered by the Proprietors, the greateſt part of whom attended this meeting; they were pleaſed after a full explanation and diſcuſſion to declare unanimouſly, their entire approbation of, and ſatisfaction in the whole of my propoſition; and therefore deſired me to ſhew my models and draughts, and explain my ſcheme to the lords commiſſioners of the ADMIRALTY, and to the corporation of the TRINITY HOUSE: and one of the Proprietors undertook to give intelligence of this to the *Admiralty* and *Trinity Houſe* reſpectively, which he did the next morning; alſo intimating, that I was then ready to depart for *Plymouth*, and propoſed to do ſo in a few days; and would wait upon them with my *models*, &c. when they choſe to appoint: and the Proprietors having adjourned their meeting to Saturday the 17th, they concluded that in this time thoſe exhibitions would be over, and the ſentiments of thoſe reſpective bodies known.

The gentleman immediately received an anſwer in writing from the ADMIRALTY, that their Lordſhips would be glad to ſee the models at two o'clock the next day; at which time I accordingly waited on them, accompanied by one of the Proprietors; and muſt own I was not a little flattered by the thorough approbation their Lordſhips were pleaſed to expreſs of my ſcheme*.

Saturday came without any other thing intervening, except my own preparations for my journey. I met the Proprietors at the time appointed; but as nothing had then been received from the TRINITY HOUSE, and the ſeaſon was ſo far advanced, that all delays were dangerous, in a caſe where winds and tides were concerned, and the preſent ſeaſon in hazard of being in ſome meaſure loſt; therefore as the Proprietors could not anſwer it to the public, nor to the corporation of TRINITY HOUSE, if they kept me in waiting; it was determined that I ſhould ſet forward early on the Monday morning following.

110. DURING the whole of my ſtay in London, I had kept a conſtant and regular correſpondence with Mr. JESSOP, concerning the forwarding of ſuch preparatory matters as I ſhould ſtand in need of on my return to Plymouth; ſo that, in that reſpect, no time was loſt.——During this interval, the Proprietors had alſo appointed a clerk to aſſiſt me in all matters of account and correſpondence, and in whatever other buſineſs I ſhould think proper to employ him. They then proceeded to give me their ultimate inſtructions, which in one ſenſe might be ſaid to be as *particular*, as in another they were *general*; and were nearly to the following effect.——To commence and carry on the works with all poſſible diſpatch.——To employ what perſons, and what number of men I ſhould think fit.——To retain, diſmiſs, or reward them at ſuch times, and on ſuch occaſions as I ſhould judge right or convenient.——To agree or contract on their behalf, with any perſon or perſons on any account whatever, relative to the rebuilding of the *Edyſtone Lighthouſe*.——To direct the whole buſineſs and all perſons I employed, and to exerciſe my diſcretion in the largeſt extent.——And, in ſhort, that I was to command without controul except from themſelves.

How much ſoever I was flattered by the thorough truſt and confidence that thoſe gentlemen now appeared to have repoſed in me; yet I was not leſs pleaſed at their delegating one of the Proprietors to

* Lord ANSON was then at the head of that Board, who together with Sir WILLIAM ROWLEY were members of the corporation of TRINITY HOUSE.

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act for them in the buſineſs of holding a correſpondence with me, and managing and directing all ſuch matters as I ſhould have occaſion at any time to reſort to them for, of what nature ſoever: and this judicious meaſure certainly tended to the ſpeedy advancement of the works; for in many inſtances while this work was carrying on, had I unfortunately been under the neceſſity of waiting for a reſolution till the individual opinions of all, or a majority of the Proprietors had been taken, much time would have been loſt, and poſſibly ſeaſons; for whatever wiſdom there may be in numbers, yet it is a trite and juſt remark, that they are generally tardy in their reſolutions; and delays ought always to be avoided, when it is poſſible, in matters the execution of which depends on *Tides*, *Seas*, and *Winds*: different judgments and different ideas there muſt naturally be expected to be among many; but, in ſuch a caſe, to enter into a debate, as to the propriety of taking any ſtep, perhaps *abſolutely neceſſary*, and poſſibly at the very time when that ſtep ſhould be *taken*, could have no other tendency except to delay and to increaſe the expence; from the fatal conſequences of ſuch circumſtances, I was however happily relieved by the reſolution of the Proprietors above-mentioned.

111. I AFTERWARDS underſtood that a verbal meſſage was delivered by the ſecretary of the TRINITY HOUSE, appointing the Wedneſday following for my waiting upon them with the models, &c. but as this would neceſſarily have created a further delay of ſome days, the remainder of the ſeaſon now growing precarious, the Proprietors did not think it proper to countermand my departure; I therefore ſet out according to appointment, very early on Monday morning the 19th of July for Plymouth; but not without greatly regretting the not having had the opportunity, as well as the advantage, of exhibiting my deſigns to the *Elder Brethren* of TRINITY HOUSE: whoſe approbation as profeſſional men, I was ſenſible would have greatly contributed to diſpel the ſurmiſes, and that kind of diſtruſt which muſt ever hang upon the minds of thoſe who feel their own judgment incompetent; and who yet think themſelves called upon to decide on ſo material a ſubject as I now had before me, though without having had the opportunity of its being properly laid before them: thoſe, by way of ſecurity to their own, generally fall in with the popular opinion; which was, *that nothing but WOOD could poſſibly ſtand upon the Edyſtone*. However I conſoled myſelf with the expectation of having a future opportunity; and that as the whole purport of the preſent remaining ſeaſon, was nothing more than cutting the rock to a ſhape that muſt in every event, render it more apt for the reception of any ſtructure whatever; I could not fear that any labour would be loſt, by any difference in judgment that could poſſibly happen afterwards.

112. THE models that were prepared and exhibited as above related ſtill remain in my hands, and Plate N° 7. is, as already mentioned, taken therefrom; for being profeſſedly an exact repreſentation *of* the rock, in the condition I firſt found it; this admits of no change: but the other model and ſection, containing the deſign *for* the Lighthouſe (which as I have before hinted, was ſubject to ſome change in entering on the detail of the work at large) no longer remains an exact model of what was executed: nor at the completion thereof, had I any perfect deſign of it in that finiſhed ſtate; but having taken memorandums of the alterations, I have been enabled to make out a due repreſentation of the work as it *now* ſtands: and as the original models, &c. ſerved very well for many years to explain the nature of the work that *had been* done; the difference not being very conſiderable, in like manner the preſent repreſentations of the work as really executed, will equally explain, what was formerly exhibited; firſt to the Proprietors themſelves, then to the lords of the ADMIRALTY, and afterwards to the honourable board of TRINITY HOUSE; who to my great ſatisfaction entirely approved thereof.

Plate N° 8. contains the elevation or preſent appearance of the Lighthouſe, as ſeen from the ſouth. ——Plate N° 9. contains a ſection of the whole as ſeen from the ſame quarter.——Plate N° 10. contains the plans of the rock as cut into dovetails, with all the courſes up to the top of the rock.——Plate N° 11. contains the plans of the firſt whole or ground courſe, and of all the courſes above it.——And Plate N° 12. is an enlarged plan and ſection of the lantern.

BOOK III.

Containing an Account of Proceedings, from the COMMENCEMENT *of the* WORK *upon the* ROCK *in* 1756, *to the Beginning of the Second Seaſon in June* 1757.

CHAP. I.

Narrative of the PROGRESS *of the Work done upon the* EDYSTONE *from my Arrival at* PLYMOUTH *in July* 1756, *to the Time of mooring the* NEPTUNE BUSS.

113. I ARRIVED at Plymouth on Friday the 23d of July 1756, having been met by Mr. ROPER at *Dorcheſter*, with whom all neceſſary matters were ſettled; among which, the price of the ſtone, the mode of admeaſurement, the number of feet (16) per ton, and the method in which we were to receive a regular ſupply, were not the leaſt material. On my arrival, I found that Mr. JESSOP had completely fitted up, for preſent ſervice, *Hancock's Sloop*, which I had before made uſe of as an attendant; alſo, the Edyſtone boat; and a large yawl with ſails and oars; and had likewiſe got other things in forwardneſs that had been committed to his charge; and I immediately entered another able ſeaman, which, with our former crew that I had left on half pay, made the number ſix.

The *Neptune Buſs* I found was arrived, and lay in *Stonehouſe* creek; but without any order for the exhibition of a temporary light: on the contrary, I now underſtood, that ſome difficulties had ariſen between the Trinity Board, and their leſſees of the Lighthouſe*; and that in conſequence of this, two of the members of that corporation were then in the country, preparing another veſſel for that purpoſe. It ſeemed therefore to me moſt likely, that the Neptune Buſs, if not applied as a floating light, would be deſtined to be a ſtore-veſſel for the ſervice of rebuilding the Lighthouſe; and this occaſioned me ſtill to ſuſpend all orders for the preparation of chain moorings, till I ſaw the event of this buſineſs: but that our immediate ſervice might not be hindered, I ordered the ſloop's cable to be very well *wormed* and *ſerved* †, and a new one to be prepared in addition, in the ſame manner.——The weather proved not ſuitable to go out to ſea when I came, and I was informed, that the ſeaſon had never been very favourable for our ſervice ſince my departure from Plymouth in May: however, Sunday the 26th appearing promiſing, though there was but little wind, and being deſirous to reconnoitre the place, as our ground cables for the ſloop could not yet be got ready, I determined to try what we could do in rowing out in our new yawl, with the aid of ſuch breezes as might happen: the ſloop being ordered to follow us as ſhe could; that in caſe a freſh

* Said to be owing to an Application of the *Merchants* of *London* to that Corporation, that they would take the propoſed temporary light under their own management and direction.

† The *worming* of a cable is to inlay ropes ſo as to fill up the ſpiral furrows between the *Strands* of the cable, and to bring the ſurface upon a level; which not only ſtrengthens the cable, but enables it better to endure friction againſt the ground: and the *ſerving* of a cable is the wrapping it round with another rope whoſe coils are cloſe to each other, like the baſs ſtring of a *Violin*; and to render this ſtill more effectual, the cable is often firſt bound round with canvas, and then the ſervice-rope wound tight upon it, which was done in the preſent caſe.

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of wind ſhould ariſe from the north, which would be very unfavourable to our return, ſhe might then get out to ſea, and bring us back, or make her courſe good to land us at *Fowey*, or ſome other convenient port.——We went out about eight in the morning; and with four oars, without aſſiſtance from the wind, got to the Edyſtone. I landed there, ſtaid an hour, found every thing exactly as I had left it; and after making ſome remarks relative to fixing the center of our propoſed building, got back to Plymouth at four in the afternoon. In our return we met the ſloop in the entrance of the Sound, ſhe not having been able to get any farther.

114. AFTER this day the weather came on bad and rainy, and continued ſo till Tueſday the 3d of Auguſt; which a good deal retarded our work in preparing the cables, &c. However, the interval was of ſo much length as to allow us to prepare every thing fully for the ſea.——I made uſe of this time alſo in preparing and eſtabliſhing our working companies upon the plan I have already mentioned, § 85. ——I made choice of and agreed with Mr. THOMAS RICHARDSON, a maſter maſon of Plymouth, of good reputation, to act as foreman to one of the companies; and alſo with WILLIAM HILL, who had been ſome time foreman to another maſter maſon of the ſame place, to act as my other foreman. I likewiſe entered three maſons and nine tinners*, as a company to go out with Mr. RICHARDSON to take the firſt turn or week, commencing from Saturday the 31ſt of July.——Mr. JESSOP I appointed my general *Aſſiſtant*. The wages of the foremen, while out at ſea, were to be 5s. per day certain; and for every hour ſpent upon the rock, the further premium of 1s. But when employed in the work-yard, or otherwiſe on ſhore, their wages were to be 3s. 6d. per day. The wages of the maſons were to be 2s. 6d. per day certain at ſea, with a premium of 9d. per hour; and the tinners 2s. per day certain at ſea, and 8d. per hour. In the work-yard or on ſhore, the maſons were to have 20d. and the tinners 18d. per day; and to be paid for over time, when required to work, at the rate of double the price per hour, that their day wages came to, as propoſed in my original plan: and that the ſeamen might not want inducement to do their utmoſt in landing the workmen at the Edyſtone as early as poſſible at every opportunity, and ſupply them with what was neceſſary for keeping them at work; over and above their weekly wages, which were ſettled at 8s. per week, they were all to receive a premium for every landing upon the rock; the maſter ſeamen of 2s. 6d. and the ordinary of 2s. to make their advantage equivalent to that of the other workmen, in whatever ſervice the ſeamen (who were *conſtantly* on duty) might be employed.——Mr. JESSOP as general aſſiſtant was to have 10s. 6d. per day at ſea, and 5s. per day at land, as he had been uſed to be paid; and every one was to ſupply himſelf with victuals.

In this interval I alſo agreed with Mr. DELACOMBE for half an acre of ground for a work-yard; being part of a field lying on the weſt ſide of Mill Bay (as before deſcribed, ſee Plate N° 17, Fig. 1.) which he rented of Lord EDGCUMBE, and which by permiſſion of his Lordſhip, was to be applied to this uſe; and I marked out the yard and agreed for the fencing it with boards†.——Within this time Mr. JOHN HARRISON, the perſon made choice of as clerk to the Edyſtone works, arrived from London, with whom I digeſted a plan for the keeping our accounts and correſpondence, and for the diſtinct noting of ſo great a variety of articles as muſt neceſſarily occur, we found it expedient to open no leſs than 14 different books.

115. MATTERS being thus put in a train on ſhore, and the weather having become more promiſing, on Tueſday morning the 3d of Auguſt, Mr. RICHARDSON and company embarked in the ſloop with her ground tackle‡ on board; attended by myſelf and Mr. JESSOP, and alſo the yawl properly manned: the wind was favourable at N. W. on ſetting forward, but preſently changing to W. and afterwards to S. W. our progreſs towards the rock was not ſo ſpeedy as we all earneſtly wiſhed. Having got within

* The Corniſh miners, as the general produce from the mines in *Cornwall* for ages paſt has been *tin*, are commonly called *tinners*; and at this time many of them came to Plymouth to work as labourers.

† Upon this ſcite the *Baths* and *Long Room* have ſince been erected, as alſo the *Marine Barracks*.

‡ The general term for cables, anchors, and all other ropes and furniture for *mooring* or anchoring of veſſels.

two

two miles of the Edyſtone, and the weather being moderate, I went into the yawl attended by Meſſrs. JESSOP and RICHARDSON, and by the help of oars landed on the rock at half paſt four, where having brought ſome tools with us for that purpoſe, I proceeded to fix the center, and to lay down the lines of the intended work upon the ſurface of the rock; and being followed by Mr. RICHARDSON, he with ſharp picks left indelible traces of thoſe lines, ſo as to be proceeded upon by the workmen whenever they ſhould be able to land. This work however could not be farther proſecuted for the preſent; for at ſix the ſea began to be ſo unquiet, as to make it adviſable to quit the rock, and return to the ſloop: and before the ſloop could gain a proper place for mooring, the ſea became ſo rough, that it was judged impracticable to moor her that evening, or even to lie ſafely at anchor; we therefore went to *Cawſand Bay* in hopes of better weather the next morning.

Wedneſday the 4th, the wind having continued to blow freſh all the preceding night, and ſtill more ſo at four in the morning, I returned with Meſſrs. JESSOP and RICHARDSON to Plymouth in the yawl to expedite matters on ſhore, leaving the company on board the ſloop.——Still the uncertainty of weather ſeemed to purſue this undertaking; but comfort aroſe from the reflection that as there *had* been opportunities to former undertakers enabling them to fix and complete their reſpective works, it was by no means to be doubted but that circumſtances would again occur either ſooner or later, ſo as to allow us effectually to purſue the preſent intention; and that, whenever we could get a veſſel well moored near the rocks, many opportunities would be found of landing and purſuing the work, which otherwiſe muſt be loſt by our being obliged to proceed from the ſhore, as was in reality the caſe in the inſtance juſt given.

116. THURSDAY the 5th, the wind being moderate at W. I went on board the yawl at ſeven in the morning attended by Meſſrs JESSOP and RICHARDSON, and on reaching the ſloop in Cawſand Bay we immediately weighed and ſailed; and arrived off the Edyſtone at two, when we again proceeded towards mooring the ſloop; but before we got our moorings down, the wind again came on ſo freſh, that we had only the choice of dropping them in a ſituation not quite eligible, or experiencing a further delay: the former was choſen, as the leſs of two apparent evils; and upon doing this we found ourſelves too near the S. E. reef, in which ſituation, in caſe of a hard gale at N. W. and any failure in the moorings, the veſſel would be upon the rocks before her ſails could be got up and ſet: however, being free from preſent danger, and every one anxious to make a beginning, as the tide now ſerved, the whole company landed upon the rock, and immediately began the work, which was purſued for about four hours, when the ſea advancing upon us, we quitted the firſt tide's work at half paſt eight, with which we had reaſon to be ſatisfied. The yawl was then diſpatched home with the blunt picks, with orders to return immediately; as the ſloop being left with only her ſmall boat, the yawl's ſervice would be wanted the next tide, if favourable to land the company: and to avoid delay, directions were given, that the Edyſtone boat was to bring out the tools when ſharpened.

Friday the 6th, the yawl being returned in due time, all hands landed before ſun-riſe and worked that tide ſix hours: in the afternoon's tide, the company landed again, and continued the work, by the light of links, till ten at night. At ſeven in the evening the Edyſtone boat arrived with the ſharp tools, and was immediately ſent back with the blunt ones: and this day I got nearly the whole of the work laid out, as is particularly expreſſed in Plate N° 10. Fig. 1. which ſhews the dovetail receſſes, and two new ſteps which were formed below all the former, according as it was ultimately finiſhed for the reception of the ſtone-work: only that (to ſave a figure) the firſt courſe of ſtone is here expreſſed as laid; the doing of which was in reality the beginning of the work of the next ſeaſon: the whole object of the work of this ſeaſon being to get the ſurface of the rock converted from the ſhape and condition in which we found it, according to Plate N° 8. Fig. 1. to that of the figure juſt referred to: we alſo made good diſpatch with the cutting of the rock, conſidering the exceeding toughneſs as well as hardneſs of it.

117. IT might ſeem at firſt ſight, that a greater diſpatch would have been made by the uſe of *Gunpowder* in blaſting the rock, in the ſame manner as is uſual in the mines, and in procuring limeſtone from the marble rocks in the neighbourhood of Plymouth: but though this is a very ready method of working hard

hard and close rocks, in proportion to the dispatch that could be made by picks and wedges; yet as a rock always yields to gunpowder in the weakest part, and it is not always easy to know which part is weakest; it might often have happened, if that method had been pursued, that instead of forming a dovetail recess such as was required, the very points of confinement would have been lost.——Besides, the great and sudden concussion of gunpowder might possibly loosen some parts that it was more suitable to the general scheme should remain fast. For these reasons I had previously determined to make no use of gunpowder for this purpose.

118. SATURDAY the 7th, the company again worked six hours in the morning's tide; but this being the day established for the change of the company, they had been but half an hour at work, when WILLIAM HILL and his company arrived in the Edystone boat, with sharp tools, and landed, taking up the tools that RICHARDSON's company had in hand.

Having now completed the lines upon the rock*, I returned with RICHARDSON and company, leaving Mr. JESSOP to attend HILL and his company for the following week. Our establishment respecting seamen was as follows: three of the seamen being left with the *Rock* or *Out-company*; one of them constantly remained in the store sloop; and the other two attended the workmen with the yawl, lying along side the rock at the landing-place in the Gut, to carry any thing that might be wanted to or from the sloop. The other three attended the Edystone boat, being now a passage-boat from the sloop or rock to the shore; and though such a kind of boat was easily managed by two men in ordinary, yet, as expedition was most necessary in the calmest weather, we now allowed three, that two might row, and the other steer.

119. I SHALL in this place take the opportunity of observing, that fine settled weather in these parts is almost constantly attended with *Land* and *Sea Breezes*: for about sun-set, or often before, the wind begins to blow a fresh breeze from the northerly points, which is from the land towards the sea; and in one, two, or three hours after sun-rise, it changes to the opposite direction, and blows a fresh breeze from the southerly points, that is, from the sea towards the land: and this circumstance proved in reality one of the greatest advantages towards helping forward our work; as by this means, the Edystone boat was enabled to make one regular *trip* every twenty-four hours; it being so contrived that she should depart in the evening, and return some time in the forenoon of the next day, sooner or later as the wind and tides served.

120. HAVING given this specimen of the mode of our operations in good weather, it is unnecessary to proceed with the account by way of journal, though I am sufficiently enabled to do it, having kept a regular one from the 23d of July, the day of my arrival at Plymouth to begin the works, to the completion of the same: a copy whereof was made out and sent weekly to Mr. WESTON, for the information of himself and the rest of the Proprietors. I shall therefore now only remark that from the first tide upon the rock, which was the 3d of August, the work was incessantly pursued at the average rate of about five hours per tide, with very little interruption, till Sunday the 15th, when the wind began to blow fresh at S.E. and shall content myself with remarking such occurrences as were more particularly deserving of our notice during this interval.

121. THE very evening I sailed with RICHARDSON, &c. for Plymouth, the seamen on board the sloop discovered a difference in the riding of the vessel, and that in all probability one of the anchors had dragged; and getting sufficient help from the other seamen and company, to heave up the ground cable, they found, that not only the *service* and *worming* were cut, but the cable itself was so greatly injured by the sharpness of the rocks, though it had been down not much more than twenty-four hours, that had the weather been rough, it would scarcely have borne to have been heaved up.——Had this not been disco-

* Here may be observed the great utility of the time employed in getting dimensions, and forming accurate models of the rock, and of the work immediately connected with it, before the operation was actually begun; for had the *contrivance* been to make out, while the workmen were upon the place, it is easy to judge of the loss of time, and number of mistakes and incongruities, that must have attended it.

vered, as the wind in the night came on to blow freſh from the N.W. the cable would in all probability have parted, and the veſſel gone upon the S.E. reef of rocks; the conſequence of which might have been fatal to all on board. Mr. JESSOP, however, after getting the cable refitted in the beſt manner poſſible, determined with the aſſiſtance of HILL's company, to weigh the anchors and ſhift the moorings, ſo that the ſloop might have the chance of riding in a more ſafe ſituation; that is, at about 100 fathoms to the north of the Gut, where it was judged the rocks might be leſs ſharp, as the ſoundings were tolerably regular; and where alſo, in caſe of breaking looſe, a north-weſt wind would *ſhoot* the ſloop clear of the houſe reef. This in reality was every thing that could be expected under ſuch a circumſtance: for as a north wind proceeding from the neareſt land is productive of the leaſt ſwell, there would in the diſtance of 100 fathoms be a probability of hoiſting a ſail, and ſteering the veſſel clear of rocks, through ſome of the paſſages (ſee the Plan, N° 3): yet after all, without *ſome riſque* to every individual, there was no proſpect of re-erecting the Edyſtone Lighthouſe. This operation having been performed the ſame evening, there was little or no time loſt to the work upon the rock.

122. ON Friday the 13th, which was in the courſe of HILL's company's week, the veſſel fitted out as a *floating Light* by the TRINITY-HOUSE, ſailed from Plymouth; and being got out to the vicinity of her place of deſtination, exhibited a light the ſame evening. Saturday morning the 14th, being the day of RICHARDSON's company going out to change, I went with them at ſeven, and arrived at the rock at twelve: when I found the ſeamen on board the ſloop buſily employed in piecing the ground cable, which this forenoon had again parted, having been cut by a rock in the ſame manner it had been on that day ſe'nnight. As ſoon as the cable was refitted, the moorings were replaced, and at four P.M. I landed upon the rock with Meſſrs. JESSOP, RICHARDSON, and C°, and ſtaid an hour to examine the work that had been done; HILL's company having worked every tide in the preceding week, amounting to 64½ hours: and having found the work properly executed, I returned on board the Edyſtone boat with Meſſrs. JESSOP, HILL, and C°, and landed at Plymouth the ſame evening.——From this view of the work upon the rock, I judged that nearly one third of the whole was already diſpatched.——The great wages that had been made this laſt week by HILL's company (amounting to above three guineas *extra* by the foreman, as alſo by the workmen in proportion) had the good effect of producing ſo much ſpirit in them, and that of emulation in RICHARDSON's company to do the ſame, that we now looked on the performance of the work of this ſeaſon as quite within our power: provided, that we got a veſſel in due time with *chain* moorings, which could better contend with the rocks, and keep her in her due ſituation: and as this day the *Corporation*'s veſſel compleated her moorings, I judged it would not be long before the *Neptune Buſs* would be delivered to my uſe. This was the more deſirable, becauſe the floating Light lying as we judged at the diſtance of two miles, in a direction W. by N. by the compaſs, the veſſel could not in that ſituation be of any uſe to us in carrying on the building, notwithſtanding the Light might be in a very proper ſituation to give timely notice to homeward bound veſſels from foreign voyages, they being moſt likely to be out in their reckonings, in coming into the Channel in foggy weather.——This however occurred, reſpecting the poſition of the floating Light; that in caſe we ſhould happen in our yawl to be caught with a freſh of wind from the Eaſterly points, ſo as not to be able to reach our ſtore veſſel from the rock, we might find a place of refuge in the floating Light.

123. ON Sunday the 15th, the wind was ſo freſh at S.E. as to put a ſtop to the work upon the rock; and in the courſe of the day the ſea became ſo rough, that at five P.M. Mr. RICHARDSON, and the ſeamen on board, fearing ſome greater damage might happen to their moorings, flipped their *Bridle Cable**, having put a ſufficient buoy upon it, and brought the ſloop into Cawſand Bay, where ſhe lay till Monday at midnight; but the weather then mending, they got back to their moorings on Tueſday morning at four, and ſoon after made a landing; but could ſtay only half an hour.——This day I diſpatched draughts to Mr. ROPER, according to which the Portland ſtone for the two firſt courſes above the rock

* When a veſſel is moored by laying down a cable upon the ground, with an anchor at each end, then another cable attached to the middle of the ground cable is called the *Bridle Cable*.

were

were to be rough *ſcappelled* *; it being agreed on my former interview with him at *Dorcheſter*, that in order to ſave time, draughts for the preſent would be ſufficient.

In the afternoon of the day (Tueſday) that Mr. RICHARDSON and C° regained the moorings, they were able only to work a couple of hours upon the rock, before they were glad to get on board their veſſel, and ſoon after they were obliged to quit their ſituation, and come again into Cawſand Bay; where adverſe weather cauſed them to remain till Thurſday evening; when it becoming more promiſing, that matters might be expedited as much as poſſible, I went on board the ſloop, and ſailed with the company to the Edyſtone; but found the weather there too violent to attempt any thing upon the rock, or even to lay hold of the moorings; we therefore judged it prudent again to return to Cawſand Bay with the ſloop on Friday morning.

Saturday morning the 21ſt, HILL's company, who had been employed at Mill Bay during the paſt week in clearing away the mud, and deepening the channel, went in the Edyſtone boat to Cawſand Bay, and the companies at this time ſhifted there. In the afternoon HILL's company attempted to go out to ſea; but the wind proving too freſh at South, they were obliged to put back. Sunday morning they again attempted it, got out to, and laid hold of the moorings, and landed; but after ſtaying half an hour, were obliged to quit the rock; and in the afternoon, though the weather was fine, and apparently favourable at Plymouth, yet there was ſo much ſea at the Edyſtone as to prevent their attempting to land. That no time might however be loſt, on Monday noon Mr. JESSOP went out in the Edyſtone boat; but the wind being contrary, after attempting to beat out, he came to an anchor in Cawſand Bay in the evening; and in the night the ſloop returned to the ſame place, having found the ground cable cut a *third* time.

124. THE next day I received an order from the Proprietors to make uſe of the *Neptune Buſs* as a ſtore veſſel, for expediting the work of the houſe: I therefore determined to loſe no time in getting her out to proper moorings; and having inſpected her along with Mr. JESSOP, and found room ſufficient in her for the men, without unloading any part of the timber that was in her for buoying her up in caſe of accident (as has been already mentioned § 107.) we determined to moor her without alteration, except *unſhipping* the tackle belonging to the lantern; which, however, was preſerved entire, ſo that it could have readily been replaced, in caſe any accident had made it neceſſary to apply this veſſel to the purpoſe for which ſhe was originally intended.

On Friday the 27th the wind came fair, and the weather moderate; ſo that HILL and C° went out in the ſloop from Cawſand Bay, and got to the Edyſtone; but the buoys being driven away, they were not able to regain the moorings; they therefore came to an anchor, which enabled them to work every tide while they ſtaid; though on account of the ground ſwell from the S.W. they made but ſhort tides. During this time the moorings were recovered by *ſweeping* for one of the anchors, and the ſloop was once more eſtabliſhed thereat.——It was not till Sunday the 29th that the Buſs was cleared of unneceſſary ſtores, and fitted for the ſervice of the building; but the weather not ſuiting to carry her out, RICHARDSON and C°, who were to have gone in her, went out in the Edyſtone boat. The wind being then moderate, and there being apparently good weather for working upon the rock; finding they made but little way towards it, as the wind was right ahead, the whole company, eager to get upon the rock, took to the yawl which attended them, and making a great exertion, rowed out, and landed about noon, and received the tools from the hands of HILL and C°.

125. TUESDAY 31ſt. This morning the wind being favourable, the Buſs was brought out of *Stonehouſe Creek*; but all, that from circumſtances we were able to do this tide, was to *warp* her out to one of the *Tranſport Buoys* belonging to His Majeſty in *Hamoaze*. In the mean time, that no opportunity might be loſt to the Out-company on the rock, ſharp tools and other neceſſaries were diſpatched in the yawl, along with Mr. JESSOP; who returned the ſame evening, reporting all well; RICHARDSON and C° being cloſe at work.——Wedneſday morning, 1ſt of September, I went on board the Buſs with Meſſrs. JESSOP, HILL and C°, and four of the ſeamen. There was a freſh breeze, which not being quite

* A term for ſuch work as could be done with the *Kevel* before deſcribed. See § 93.

in

in our favour, we propoſed, by making a *tack*, to get the buſs fairly out into the Sound; but in attempting to tack, we found our veſſel would not *ſtay*, and after endeavouring at it twice more, we were glad to let go an anchor to prevent falling upon the rocks; and thus we loſt this day, to our no ſmall mortification: and this was the firſt of a train of incidents that gave me a leſs favourable idea of our new veſſel than I had pre-conceived; and in the end ſatisfied me, that however completely the *Neptune Buſs* was fitted for the ſervice for which ſhe was intended, yet ſhe was not at all adapted to our *particular* ſervice, inſomuch that I had every reaſon from the ſequel to ſay, that ſhe proved not only the greateſt clog and impediment we met with in the whole courſe of the work, but the real ſource of almoſt every diſaſtrous event that happened to us: ſo that had the Proprietors diſpoſed of her in any way, rather than deſtined her to our uſe, the charge of a new veſſel conſtructed upon the plan propoſed § 77, would have borne no proportion to the difficulties, diſappointments and loſſes the ſervice in reality ſuffered from her.

Thurſday Sept. 2d. This morning the wind being at N.E. and of courſe favourable for carrying the Buſs out of the Sound, at the proper time of tide we weighed, and ſailed about nine in the morning; but before we got out to ſea the wind became Eaſterly, and as we got without the Heads, it came to S.E. ſo that the wind was then nearly upon our beam, and conſequently ſtill fair; but as it was not very freſh, we made but little way; and our way was ſtill leſs, on account of our veſſel being ſo heavy a ſailer: we continued however moving through the water; and as we had reaſon to ſuppoſe the work was going briſkly forward upon the rock by RICHARDSON and C°, delays of every other kind ſeemed within the bounds of patience. About five o'clock in the afternoon, judging the Out-company would be in need of ſharp tools, I went in the yawl with one of the ſeamen and two of HILL's men, got to the rock, landed, and had the pleaſure to find RICHARDSON and C° at work, and proceeding properly. In the mean time the Buſs came forward, and at eight in the evening, when ſhe was about 2½ miles from the rock, the wind dying away, and the tide being againſt her, ſhe came to an anchor; and ſoon after I returned to the Buſs with the blunt tools, and diſpatched them with HILL, and four of his men in the yawl to Plymouth, with orders to return as ſoon as they were ſharpened.

Friday the 3d, there being a freſh breeze at N.E. we got under way this morning at five; but it ſoon becoming Eaſterly and gentle, it was nine o'clock before we got near the rock: we then dropped anchor, the rock being E.S.E. diſtant about half a mile. RICHARDSON's company leaving the rock ſoon after, I ſent for ſome of them to aſſiſt in warping the Buſs to a proper poſition for dropping one of the mooring anchors: and being at that time joined by the hands in the yawl, who were now returned from Plymouth, we proceeded to the buſineſs of mooring; which to *us* was a conſiderable operation: but to make it intelligible to the reader, it will be neceſſary to deſcribe the nature of the *ground-tackle* our veſſel was furniſhed with for this purpoſe.

126. WE had two mooring chains of 40 fathoms in length each; and the *bolt*-iron of their links being about 1¼ inches diameter; every fathom of this chain weighed 120 lb. ſo that each chain amounted to the weight of 2 tons 2¾ cwt. and conſequently the two chains to 4 ton 5½ cwt.; this, with the two mooring anchors of 12 cwt. each, made the weight of anchors and chains together 5 tons 9½ cwt. and with the further addition of a large ſwivel, with ſhackles and bolts, the weight of iron in this ſet of moorings might fairly be accounted ſix tons. The laying theſe down properly ſeemed ſo formidable a buſineſs, that I was told by my friends at Plymouth, the force of hands and purchaſes we had, would never be ſufficient for the purpoſe; but that I ſhould be under the neceſſity of getting it done by the *Maſter Attendant*, and proper people from the *King's Yard*, with their *Mooring Barges*, &c. and to this I was ſeriouſly adviſed. I had no reaſon to doubt of the good will and beſt aſſiſtance of the Commiſſioner, whenever it was in reality wanted; but always wiſhing to be maſter of my own operations, and foreſeeing how much delay might ariſe from the carrying out the *King's* Mooring Barges ſo far to ſea, where they could not *live* but in *fine* weather, I was deſirous that the moorings might be put down from the Buſs herſelf; and being clear in the operation, and having the aſſiſtance of ſix able ſeamen, together with that of the two companies of ſtout hands, and the advice and experience of Mr. JESSOP, I proceeded to the buſineſs without apprehenſion of difficulty.

According

According to the manifeſt intention of theſe moorings, the two 40 fathom chains were to be joined together by one of the loops of the large ſwivel, the other end of each chain being attached to its reſpective mooring-anchor; one of the anchors therefore being laid to the weſtward (or down channel) from the ſwivel, and the other anchor as much to the eaſtward, or up channel from the ſame; the *bridle* cable proceeding from the bows of the veſſel, being *bent*, or annexed to the upper loop of this ſwivel, the veſſel would ride thereby fairly in the middle between her two anchors. It occurred to me, however, that according to this conſtruction, either a conſiderable part of the two chains muſt be hoiſted, and kept ſuſpended above the ground by the bridle cable, and hang continually upon the bows of the veſſel, or elſe, if the ſwivel, in the up and down motion of the veſſel by the waves, was ſuffered to ſtrike the ground, that there would be danger, not only of cutting the cable, but of breaking the ſwivel, by its violently pitching upon the rocks in ſtorms and hard gales of wind. To prevent this, I conſidered, that the ſea being liable to come much more heavy and violent from the weſtern than from the eaſtern points of the compaſs, if 40 fathoms of chain were competent to the ſtrain from the Weſt, 40 fathoms would be more than ſufficient to reſiſt the ſtrain from the Eaſt; and conſequently five or ſix fathoms of it might be ſpared to act as a bridle; ſo that, inſtead of having the two chains joined by the ſwivel, the weſtern chain ſhould be joined to the eaſtern at five or ſix fathoms from its extremity, by a bolt and ſhackle, and the ſwivel be applied to the end itſelf. Thus the weſtern chain of 40 fathoms lying upon the ground, and 34 or 35 fathoms of the eaſtern alſo, and the bridle cable being attached to the upper loop of the ſwivel, when the veſſel was riding at her moorings, there would be five or ſix fathoms of chain, beſides the ſwivel, between any part of the cable and the ground; whereby not only the ſwivel itſelf would be preſerved, but the cable would be prevented from ever touching the rocks. Having prepared our ground tackle according to this plan, we proceeded to lay them down as follows.

127. OUR veſſel was anchored too much to the weſtward. Soon after RICHARDSON's company came on board, it became tide of flood; and the water having riſen half its height, agreeably to what was mentioned, § 3. it would then begin to run from Weſt to Eaſt; and therefore, leſt when we weighed anchor we ſhould drive eaſtward with the tide, and overſhoot our mark, we immediately let go another ſmall anchor or *Catch*, and *paied* out the *Hawſer* * by which we were riding; at the ſame time paying out the hawſer of the catch-anchor; by which means the veſſel drove eaſtward till the whole of the firſt hawſer was run out: we then weighed our firſt anchor (by means of its buoy-rope with the yawl) and heaving in its hawſer ſhort, we again dropped the firſt anchor, and paied out the hawſer of the other; and thus alternately, weighing and paying out, the Buſs drove to her proper place, to the north of the rock; where, at the diſtance of about 300 fathoms, we found 20 fathoms water.——At this depth I thought it imprudent to drop our mooring-anchors, in ſuch manner as with their chains to run *amain*; as this might break the anchor by its fall upon the rocks; or by cracking it we might afterwards be deceived: ſo I took the reſolution (in order to prevent damage) to lower the anchors and chains leiſurely and gradually.

The windlaſs of our Buſs, though a very good one for general uſe, was totally unequal to ſuch a purchaſe; and here indeed we ſhould have been at a ſtand, or obliged to run ſome riſk in caſe we had not been better provided than my friends at Plymouth were aware of. This furniſhed the firſt occaſion of uſing the large *purchaſe tackle* of 20 ſheaves, that I got prepared while in London, and which is mentioned § 106. Thoſe blocks being *reeved* and brought together, we fixed the ſtanding block to the ſtern timbers of our veſſel, and diſcharged from one of the bows one of the mooring anchors, attached to its chain, which went over a ſtrong iron roller very well fixed, and ſecured upon a *Davit* †, in place of the *Hawſe* hole, intended for the bridle cable to bear upon, and facilitate the getting in of the cable, or weighing the moorings. The anchor thus diſcharged remained ſuſpended by about two fathoms of the chain,

* A rope of a ſmaller ſize than the cable, and *laid* or twiſted in a leſs degree, ſo as to become more ſoft and pliant.

† A piece of ſtrong timber overlaying the bows of a veſſel, containing ſheaves, or a roller for purchaſing the anchor; its tail being ſecurely fixed upon the Deck.

which, after having paſſed the roller, was ſtopped from running further out by ſtrong *Salvagees* *; then bringing the chain along the deck to the moveable purchaſe block, and hooking it to one of the links, we lowered the anchor perfectly at our eaſe, again ſtopping the chain with the ſalvagees, when the moveable block was come near the *Davit*; and then extending the chain upon the deck as before, the block was again hooked; and in this way we proceeded *ſlitting* the tackle and lowering till our anchor was grounded. As we foreſaw that the tide running caſtward would be far ſpent before the firſt anchor was got to the ground, we previouſly determined to put down the eaſtern anchor firſt: and it was grounded ſomewhat before the turn of the tide to the Weſt.

In this poſition we ſtaid till *Still* water, and then having got the hawſer of the ſmall anchor through the ſtern opening, and forward to the windlaſs, we were thereby enabled to heave the veſſel aſtern weſtward; in which we were ſoon aſſiſted by the tide: and thus, the chain being paied out, under the command of the great blocks, and the veſſel being heaved weſtward by the hawſer, the whole of the chain was laid upon the ground in a ſtraight line Eaſt and Weſt: and it is obvious, that after the whole of the eaſtern chain was let go, as far as its junction with the weſtern chain, and that junction was completed, then the five or ſix fathoms of the eaſtern chain reſerved for a bridle, as well as the bridle cable affixed thereto, muſt be *paied* out, or let go with the other.

We proceeded as above till the whole of the weſtern chain was gone out, except as much as was neceſſary to reach to the ring of its intended anchor; which being upon the bow of the veſſel, and neceſſarily at ſome diſtance from the davit-roll, here occurred a difficulty in getting the whole grounded in the ſame leiſure manner, without the riſk of letting the anchor and 20 fathoms of the chain go over board all together.——For this purpoſe, we got the anchor as near the bowſprit of the veſſel as poſſible; and paſſed a ſmall rope ſeveral times round the arms of the anchor, and round the bowſprit of the veſſel, as cloſe as poſſible to the ſtem upon which it reſted, and made it very ſecure: we then let go the anchor from the bow, which of courſe became ſuſpended by the bowſprit, with the *Peak* upwards, and juſt above the water's ſurface. We now lowered the weſtern chain till it became ſuſpended by the anchor; which, with the chain down to the ground, now hung at the bowſprit. In this ſituation a ſtrong hawſer, of a ſufficient length to reach to the bottom double, being *paſſed* under one of the arms of the anchor, and the two parts being brought together over the davit-roll, and to the main blocks, the whole ſuſpenſion was in that manner *purchaſed*; and the ſmall rope being looſened, the anchor and chain were then let down by the double hawſer: and ſtill heaving the veſſel weſtward, this weſtern anchor was quietly laid upon the ground; and both ends of the double cable being on board, we were enabled, by letting one part go, to free it of the anchor.—We were ſo fortunate as to have an exceeding fine and calm day for this operation; by which means the whole was performed without the leaſt accident.

128. ON Saturday the 4th of September I landed at ſix A. M. and found the work to be in the following ſtate. The two new ſteps at the bottom, and all the dovetails were roughed out, and ſome of the beds brought to a level and *finiſhed*; and I judged that full one half of the work I intended to be done on the rock this ſeaſon was completed.

While I was upon the rock, Mr. JESSOP, the ſeamen, and HILL's company were employed on board the buſs, heaving in the ſtray cable, weighing the anchors, and getting the buſs to rights at her moorings. The tide's work being done at ten, I returned to the buſs with RICHARDSON and Company, and in the yawl to Plymouth; which paſſage, being in a calm, was rowed in four hours.——On Monday evening the 6th the ſloop was brought home, and the ſeamen reported, that on weighing her anchors, they found the ground cable almoſt cut in rags from end to end.

* *Salvagees* or Selvagees are ropes made with the yarns laid parallel and untwiſted; being ſlightly bound together by paſſing a ſingle yarn round the bundle, which renders them not only the moſt pliable of all others, but the ſtrongeſt poſſible to be made with that number of yarns. Properly ſpeaking, they are in the form of loops, or endleſs ropes; being made by paſſing a yarn round two fixed pins, as many times as is judged neceſſary for the ſtrength intended; the diſtance of the pins regulating the length of the loops according to their uſe.

CHAP. II.

Sequel of the OPERATIONS *upon the* ROCK *of the Firſt Seaſon of* 1756.

129. OUR Buſs being now ſatisfactorily moored, and a regular intercourſe eſtabliſhed between her and the ſhore, there was nothing to hinder the companies from changing regularly every Saturday, except bad weather; nor from working upon the rock, whenever the leaſt interval of good weather concurred with a proper time of the tide to render it practicable: it will therefore now be only neceſſary to recount ſuch circumſtances as happened out of the uſual courſe of proceedings; or ſuch as may deſerve particular notice.

On Tueſday the 7th I diſpatched to *Portland* the draughts for the ſix *foundation* courſes, that were to be employed in bringing the rock to a level; which, with the draughts for eight that I had before diſpatched, compleated the order for the whole quantity of *Portland Stone* to be uſed in the *ſolid* up to the entry door; being all that we could expect to ſet in place, the next ſeaſon. The rock was not indeed yet ready for compleating the exact moulds for thoſe ſtones that were to fit into the dovetails made in it: but by ordering the ſtones *large enough*, and being ſcappelled ſomething near their proper form, it would prevent loſs of time in waiting to get the true figure from the rock, as well as unneceſſary waſte.

130. NOTHING happened to prevent the companies from working every tide from the 27th of Auguſt till the 14th of September, in which time they had worked 177 hours upon the rock.——In this interval, having procured a carpenter to be applied to that purpoſe, I began to make the moulds for the exact cutting of the ſtones to their intended ſhapes. This was done by laying down in chalk lines upon the floor of a chamber the propoſed ſize and figure of each ſtone, being a portion of the plan at large of the intended courſe; and the carpenter having prepared a quantity of *Battens*, or ſlips of deal board, about three inches broad, and one inch thick, *ſhot* ſtraight upon the edges by a plane; thoſe battens being cut to lengths, and their edges adapted to the lines upon the floor, and properly fitted together, became the exact repreſentatives of the pieces of ſtone whoſe figure was to be marked from them, when their beds were wrought to the intended parallel diſtance.

It is obvious that there was no neceſſity for making moulds for a *whole* courſe after the work became regular; as was the 7th courſe, after the ſix foundation courſes brought the rock to a level; it was ſufficient to make one mould to each circle of ſtones, beginning with the center ſtone; but as the ſix foundation courſes were adapted to the particular irregularities of the rock, and conſequently could not be ſtrictly regular, it was neceſſary that a ſeparate mould ſhould be made for every ſeparate ſtone, compoſing that part of the work.

131. DURING this interval I viſited the rock, and on arriving there the 8th of September, was informed by Mr. JESSOP that the preceding evening, there being a very ſtrong tide, and no wind, a *Weſt Indiaman* homeward bound, and a man of war's *tender* were in great danger of driving upon the N.E. rock; but that he timely perceiving their danger, though they themſelves were not aware of it, ordered out the ſeamen and hands, who towed them off.

On

On this viſit I ſtaid two days; for as the working company had begun to take down the upper part of the rock, it was neceſſary to concert; and put in practice the proper means of doing that, without damage to what was deſtined to remain. I have already mentioned my reſolution of not uſing *gunpowder*; yet it was neceſſary, for the ſake of diſpatch, to employ ſome means more expeditious, than the ſlow way of crumbling off the matter, by the blunt points of picks.——It has been already noticed, that the *Laminæ* compoſing the rock were parallel to the inclined ſurface: and it was very probable that the chaſm, into which Mr. WINSTANLEY's chain had been ſo faſt jambed that it never could be diſengaged, extended further into the rock than the viſible diſunion of the parts: this made me reſolve to try a method ſometimes uſed in this country, for the diviſion of hard ſtones, called the *Key and Feather*; in order to *croſs cut* this upper *ſtratum* of the rock. The conſtruction and operation of the key and feather is as follows. A right line is marked upon the ſurface of the rock or ſtone to be cut, in the direction in which it is intended to be divided. Holes are then drilled by a *Jumper* at the diſtance of ſix or eight inches, and about 1¼ inch in diameter, to the depth of about eight or nine inches; the diſtances however of the holes and their diameters, as well as their depth, are to be greater or leſs, according to the ſtrength of the ſtone, in the eſtimation of the artiſt directing the work. The above dimenſions were what we uſed on this occaſion. The *Key* is a a long tapering wedge of ſomewhat leſs breadth than the diameter of the holes, and ſo as to go eaſily into them; the length being three or four inches more than the depth of the holes. The Feathers are pieces of iron, alſo of a wedge-like ſhape; the ſide to be applied to the key being flat, but the other ſide a ſegment of a circle, anſwerable to that of the holes; ſo that the two flat ſides of two feathers being applied to the two flat ſides of the key; and the thick end of the feathers to the thin end of the key, they all together compoſe a cylindric, or rather oval kind of body; which in this poſition of parts is too big to go into the holes by at leaſt one eighth of an inch; that is, in the direction of a diameter paſſing through the three parts; but in the other direction is no broader than to go with eaſe into the holes. A key and a pair of feathers is made uſe of in each hole; and the feathers being firſt dropped in, with the thick ends downwards, the keys are then entered between them; the flat ſides of all the keys and the feathers being ſet parallel to that line in which the holes are diſpoſed: the keys are then driven by a ſledge hammer, proceeding from one to another, and being forced gradually, as in ſplitting of moor-ſtone, the ſtrongeſt ſtones are unable to reſiſt their joint effort; and the ſtone is ſplit according to the direction of the original line, as effectually, and much more regularly and certainly, than could be done with gunpowder, and without any concuſſion of the parts. Had our rock been entirely ſolid, this way of working might not have been applicable, on account of the crack's going too deep; but here, when it arrived at the joint where the chain was lodged, the ſplit part became entirely diſengaged from the reſt; and in this way we were enabled to bring off the quantity of ſeveral cubic feet at a time: and thus the chain was releaſed after a confinement of above *fifty* years. The impoſſibility of diſengaging it before now appeared very evident; for the preſſure had been ſo great by the rock's cloſing upon it, as before ſuggeſted, that the links in their interſections were preſſed into each other, as compleatly as if they had been made of lead; though the *Bolt* iron compoſing the chain had been at leaſt five eighths of an inch in diameter.

132. ON Tueſday evening the 14th of September there came on a hard gale of wind at the S. W. and on Wedneſday the 15th, though the weather was moderate, yet the ground-ſwell, raiſed by the S. W. wind the night before, prevented any landing upon the rock. This being the firſt freſh of wind ſince the *Buſs* was moored, thoſe on board were not a little attentive to her.——On Thurſday the 16th I again went off to the rock, and landed, finding RICHARDSON and Company at work, though it was the firſt tide they had landed, ſince the 14th: they acquainted me that the Buſs had rode perfectly eaſy in the gale of wind they had had, and that there was no occaſion to veer out any more cable than ſhe uſually rode with; which at firſt had been hawled in ſo tight as to keep the ſwivel from the ſtriking ground, when right up and down. I found the work now in the following ſituation.——The loweſt new ſtep (the moſt difficult to work upon, becauſe the loweſt) with its dovetails quite compleated.——The ſecond ſtep rough bedded, and all its dovetails *ſcappelled* out.——The 3d ſtep (being the loweſt in Mr. RUDYERD's work) ſmooth bedded, and all the dovetails roughed out. The 4th in the like ſtate.——The 5th rough bedded, and dovetails ſcappelled out.

out:—And the ſixth ſmooth bedded, and all the dovetails roughed out.—Laſtly, the top of the rock, the greateſt part of the bulk whereof had been previouſly taken down by the *Key* and *Feather* method as low as it could be done with propriety, was now to be reduced to a level with the upper ſurface of the ſixth ſtep; the top of that ſtep being neceſſarily to form a part of the bed for the ſeventh or firſt regular courſe; ſo that what now remained was to bring the top of the rock to a regular floor by picks: and from what now appeared (as all the upper parts, that had been damaged by the fire, were cut off) the new building was likely to reſt upon a baſis even more ſolid than the former ones had done.

133. FROM the time of the hard gale upon the 14th, we found ourſelves got into a ſeries of unſettled weather; yet the ſeaſon did not ſeem ſo far ſpent, but that we might reaſonably expect a return of the land and ſea breezes, which conſtantly attended our works whenever they went on uninterruptedly upon the rock; we therefore kept ourſelves in conſtant readineſs to ſeize the lucky minutes, that the works of this year, now brought very far forward, might be *perfectly* compleated.——I attempted to go off ſeveral times, but was as often forced to return, until Thurſday the 30th, when I landed on the rock with RICHARDSON and his company; but as only about 20 hours work had been done upon the rock ſince I was there before upon the 16th, I could not expect to find much change in the appearance. However I traced the outlines upon the upper part of the rock for the border of the ſeventh courſe, all within which was to be ſunk to the level of the top of the ſixth, and all without to be left ſtanding as a border for defence of the ground joint of the work with the rock; and meaſuring the height of the top ſtep above the bed of the firſt, I found it to be eight feet four inches; which would now be the difference of level, between the weſt or loweſt ſide of the new building and the eaſt or higheſt.——On the company's returning on board the Buſs after this tide's work, the yawl's grapling got ſo faſt among the rocks, that it could not be weighed; but in the attempt, it *parted* the grappling rope: we therefore now laid down the Buſs's catch or *Kedge* anchor a little to the North of the Gut, that is, about 40 fathoms without the mouth of it*; and having *bent* to it a part of a ſufficient *Hawſer* with a large buoy at the top, that when any veſſel went in, ſhe might make faſt to this buoy, inſtead of dropping her own anchor, or grappling; this for the preſent completely anſwered the purpoſe of the *Tranſport Buoy*, mentioned § 86. as intended to be placed there.

134. ON Saturday, 2d October, there being a hard gale at S. W. RICHARDSON and company having no ſharp tools, or weather to work in, came home in the great yawl, leaving the Buſs to the care of the three ſeamen. In their way home they met Mr. JESSOP with HILL and Company in Cawſand Bay; who had ſet out that morning to relieve them; and where, after this attempt, they remained wind-bound for two days, and then were forced to return to Plymouth; ſo that now both companies were at home together, and employed upon the works in Mill Bay.

THE unfavourableneſs of the weather retarded our operations upon the rock for ſome time, inſomuch that, upon the 8th of October, the three ſeamen who had been left in the Buſs (having firſt ſecured every thing on board in the beſt manner they could) returned to Plymouth in the *little* yawl; having put up an oar for a maſt, and a blanket for a ſail. This they were under a neceſſity of doing; for as no boat had been able to get out to relieve them, ſince the departure of RICHARDSON's company, they had nearly exhauſted all their proviſions. In their paſſage home they met the Edyſtone boat going out with HILL and Company, who got on board the Buſs that evening.

135. THE equinoctial winds that now were reigning afforded me but little proſpect of doing much more work upon the rock this ſeaſon; for though a more moderate interval of weather might be expected, after thoſe winds were ſpent, before the winter came on; yet as this might probably be exhauſted in finiſhing the rock compleat for receiving the ſtone the beginning of next ſeaſon, we might find it a difficult matter to get the Buſs's moorings weighed, after that was done; as it would require the ſame good weather to take them up, as to lay them down; I therefore began to conſider whether this

* Near where the ſounding 15 (fathom) is marked on the general plan of the rocks; Plate, N° 3.

operation might not be diſpenſed with; conceiving that if a chain was affixed to the ſwivel, of a ſufficient ſize to ſupport ſo much of the main chains, as muſt be raiſed from the ground, by bringing the ſwivel to the ſurface of the water; then a large buoy (which would next year ſerve for the intended *Tranſport Buoy*) being faſtened to the top of this ſubſidiary chain; the main chains, on taking away the bridle cable, might be lowered to the bottom by this buoy chain; and the buoy thus riding all winter by its own proper chain, would afford us an eaſy means, not only of unmooring the Buſs this autumn, but of mooring her again the next ſpring.

After adviſing with Mr. JESSOP on the practicability of this method, and probability of its ſucceſs, I immediately beſpoke the buoy chain; which, as it muſt be made at Plymouth, would take ſome time; to ſave which, by reducing its length, Mr. JESSOP propoſed that we ſhould be content with eleven fathoms of buoy chain to be attached to the ſwivel, and the reſt of the neceſſary length for riding the buoy, to be of cable; which never coming to touch the ground, he conceived, that the buoy might ride out the winter juſt as well as if it was attached to a chain only. He farther propoſed to fix an under-buoy at the top of the buoy chain, which would in part ſupport it, and being eight or nine fathoms under the ſurface of the ſea, would be in a region of much greater quietude than the ſurface, in time of ſtorms; on account of which the upper or *floating* buoy might be the leſs, and therefore be leſs ſubject to any misfortune: and alſo if by any miſchance the floating buoy ſhould break looſe, or be carried away, ſtill the under buoy would ſupport its chain, ſo as to ride ſome fathoms from the ground, and in that caſe it might eaſily be recovered by *Sweeping**.

136. ON the 13th of October, the wind blowing very hard, the great yawl in riding at the ſtern of the Buſs broke looſe, having parted a double hawſer, and driving away at the rate of four miles an hour, it was impracticable to follow her in the little yawl, which was then on board; and notwithſtanding the ſpeedieſt, and moſt diligent enquiries after her, we never could hear of her again. This was a real loſs, as it had proved a boat particularly adapted to our uſe.

The weather continued ſo variable and uncertain during the whole month of October, that the out-companies had worked only 23½ hours.——It was Wedneſday the 27th before I ſaw any chance of going off to examine the ſtate of the work; and this day, the weather being moderate, I went off, and got out to the Buſs, but could not land. RICHARDSON acquainted me that his company had worked only 2½ hours this turn; for though they had tolerably fine weather over head, yet the ſea had become ſo long in ſettling at this advanced ſeaſon, that they were obliged to return to the Buſs, after two ſtrenuous but unſucceſsful attempts to land. He further reported, that there was now very little wanting to finiſh the work of the ſeaſon, but the levelling of the top of the rock. He alſo acquainted me, that the ſeamen, by the help of the company on board, had heaved up the bridle chain, till they could ſee the *Clinch* of the cable to the ſwivel; and found it ſomewhat damaged, as they judged by having touched the rocks; but the weather coming on rough before they could do any thing at it, they were obliged to lower it as it was; two days after however they again heaved it up, and repaired the clinch. The Buſs in all the paſt bad weather had indeed rode it out to admiration, having never ſhipped any water, or needed the bridle to be veered out.

137. I NOW conſidered, that nothing remained to be done of this ſeaſon's work, that could poſſibly hinder the beginning to ſet the foundation courſes, at the commencement of the next ſeaſon; as the top of the rock could be brought to a regular floor, and the dovetails in the upper ſteps corrected, in the intervals that would neceſſarily happen, while the lower courſes were ſetting. It therefore ſeemed unprofitable to continue the companies longer in a ſtate of hardſhip, merely for the ſake of having it to ſay, that the *Year's Work* as *intended* was *entirely completed*; in conſequence I was much inclined not to ſend out any more hands this ſeaſon; and ordered Mr. RICHARDSON to return with his company at the concluſion of their week, though the other company ſhould not go out to relieve them; which he did on Saturday the 30th, and brought word that they had worked four hours the day after I had left

* The operation of *Sweeping* will be fully explained hereafter.

them;

them; and I could not but notice, that on this day it was remarked at *Plymouth*, how very unpromiſing the weather was for our buſineſs; ſuch difference is there, in our climate, in a ſmall ſpace between the land and the ſea; and ſuch eſpecially between *Plymouth* and the *Edyſtone*; and this ſhewed ſtill more ſtrongly the great advantage of doing our work by a *Store Veſſel*, in preference of ſeparate voyages.——Mr. RICHARDSON alſo reported that both the buoys had broke looſe from the mooring anchors, but that every thing elſe was well.

138. HAVING received advice from Mr. TUCKER that three veſſels were ready to load with ſtone as ſoon as the weather would permit them to go to the pier, we now puſhed forward the completion of the work-yard, with its machinery, and conveniences, (See Plate N° 17.) as alſo the channel up to the Jetty Head, ſo as to be ready to receive the *Portland* veſſels: and that we might have an aſſurance of the ſtrength, and ſufficiency of our ſhears, and tackle for heaving the ſtones they ſhould ſend us, I made the following trials.——Firſt, I tried them by a ſtrain from the *Capſtand* equal to what would be required in heaving the largeſt ſtones intended for the Lighthouſe: then by a ſtrain double the former; after that by one treble; during all which every thing ſtood firm; but on applying a quadruple force, a great hook upon which the large purchaſe blocks were hung, gave way, by becoming ſtraight, as if it had been a piece of lead; but no other damage was done: ſo that I was now well aſſured of the firmneſs of all the material parts, as relative to the force to be employed, when in proper uſe: for from the above trials every thing ſtood faſt with eight ton weight upon the tackle-blocks: and now the work-yard was ready for receiving the ſtone.

139. THE month of November ſetting in with a better appearance of weather, HILL's company deſired to take another turn, which was granted.——On Sunday the 7th, I went off in the Edyſtone boat with Mr. JESSOP, and carried out battens, and the carpenter, to mould off the dovetails from the rock: but there being but little wind, it was evening before we arrived at the Buſs. HILL informed me that they had worked Thurſday night and Saturday afternoon tides, that they had had violent weather on Friday, but rode it out without fear or danger; not having veered out any more cable, or ſhipped any water; agreeing with what had been reported by RICHARDSON. At twelve o'clock at night I landed with Mr. JESSOP, HILL and Company, and the mould-maker, with the battens; the Company ſtaid 2½ hours, but the night not proving favourable to make much progreſs with the moulds, I fully explained my meaning to Mr. JESSOP; and left full directions with him about that buſineſs, which I doubted not, but his known care and exactneſs would complete to my ſatisfaction, if the weather gave leave after my return. On landing upon the rock this tide, I found the work as follows: viz. four or five of the dovetails in the upper ſteps wanting ſome ſmall amendment, that would employ as many men at each for about four or five hours. The greateſt part of the top of the rock was now brought to a regular floor, but ſome part of the N. E. ſide wanted bringing down to a level.

140. ON the 12th of November the buoy-chain for our Buſs's moorings was completed; and upon a trial thereof by means of our purchaſe tackle at Mill Bay, in manner as before, I found it to bear a ſtrain of ſix tons without any appearance of giving way, which I deemed fully ſufficient.——Suppoſing that HILL's Company, who were now going on in a ſecond week, might want proviſions, as alſo Mr. JESSOP who was with them; the next morning (Saturday the 13th) I ordered out the Edyſtone boat, but meeting with bad weather, after *beating* all day and night, it was obliged to return upon the 14th.——On the 15th I ordered the Edyſtone boat to make another attempt early in the morning, and to get out, if poſſible; ſhe ſailed, but the wind coming South, and continuing to blow hard, ſhe could not get out to ſea; and at three o'clock this afternoon we were ſurprized by the arrival of the *Buſs*, which came to an anchor at the mouth of Mill Bay. Mr. JESSOP informed me, that having ſcarcely one day's proviſion on board, and the weather then being, and ſeeming likely to continue ſo bad, that no boat could come off to them, and the wind ſtanding fair for bringing them in (not having any boat, in which they could venture home) they all agreed to ſlip their cable and carry the Buſs into harbour, leſt the wind ſhould come foul upon them,

them, after their proviſions were all ſpent.——Accordingly, after having fixed buoys upon the cable, and ſecured them as well as they could, they ſet ſail for Plymouth this forenoon: but though the wind blew a hard gale, and they came in right before it, they could not ſail at a greater rate than *three* miles an hour. When they came abreaſt of the Ramhead, they met the Edyſtone boat endeavouring to beat to windward, which was able to make but little way; and the purpoſe of the voyage being now over, they returned in company with the Buſs.——Mr. JESSOP further reported that the weather had never permitted them to go upon the rock ſince the night of Sunday the ſeventh, when I was there; which, notwithſtanding all the bad weather, was the only entire week ſince the commencement of the work, that one company or the other did not land; and it appeared by the account, that ſince the 2d of October, being 40 days, the whole of the landings amounted but to 38½ hours. Conſidering therefore the rock-work to be now as *good* as finiſhed, I was thankful that we had in reality got through what might be juſtly eſteemed the moſt laborious and difficult part of our work.——Every thing was ſaid of the eaſe and buoyancy of the Buſs's riding at her moorings in all weathers, though nothing could be ſaid in favour of her as a *Sailer*.

141. THE Buſs being thus prematurely arrived, there was a neceſſity of carrying her out again for the purpoſe of fixing the buoy-chain of the moorings: we therefore determined to warp her up to our Jetty Head in Mill Bay, that her bottom might be cleaned, previous to another voyage; and indeed on laying her upon the ground, ſhe appeared very much to need it; for though ſhe had been out of harbour but eleven weeks, the foulneſs her bottom had contracted was amazing; for it was found to be grown over with a kind of ſea-weed, reſembling *Hog's Briſtles*; which in ſome places were near ſix inches long. From hence I could not help concluding, that though veſſels while under ſail in performing their voyages, do in time get much foulneſs, yet in fact, their motion through the water rubs off many of the tender filaments of the weeds, which prevents their growing ſo rapidly as when a veſſel lies in the water, with a much leſs degree of relative motion; as is the caſe with thoſe at moorings, though in a *Tide's-way*.

142. ON Sunday morning the 21ſt of November, the Buſs being cleaned, and prepared for the ſea, and the wind fair for going out, I ſailed in her at four in the morning with Mr. JESSOP, HILL and Company, and four of the ſeamen; the other two with a part of RICHARDSON's Company being in the Edyſtone boat. As the wind was moderate at E. though our Buſs was now cleaned, and the Edyſtone boat had us in tow, yet it was twelve o'clock before we arrived at the moorings: we had however a hindrance in our paſſage of about half an hour, by an accident to one of the ſeamen, who in endeavouring to climb up the maſt of the light yawl to rectify ſomething, as he had been uſed to do in the large one, the boat overſetting he fell into the ſea: as the weather however was moderate, nothing further than a wetting was the conſequence.

In getting in the bridle cable by means of its buoys; it being a ten-inch cable, having been very hard *laid* at firſt, and having become harder by lying in the water, it was found to be ſo exceſſively ſtiff and troubleſome to manage, that it was the work of all the hands for the whole afternoon. In one place we found it damaged by fretting againſt the rocks, but being much longer than experience ſhewed to be neceſſary for us, we cut it at the damaged place.——After refreſhing ourſelves, we began in the evening to heave up the ground chains by the bridle, which employed all the hands for ſeveral hours; for though the operation of our large purchaſe-blocks was very ſure, yet having ſo many times to ſtop, overhawl, and *flit*, (as deſcribed in laying down the moorings) to get in above 20 fathoms of bridle, the work could not go on very ſpeedily; and indeed without the purchaſe-tackle, we could not have done it all: however, at three o'clock in the morning of the 22d, the ſwivel was got above water.——At this time the wind blew a ſmart breeze at E. which gave us ſo much motion, that we found it exceedingly difficult, eſpecially as it was very dark, to get the forelock of the bolt and ſhackle clinched, by which the buoy chain was attached to the great ſwivel: this was however effected; and as much depended upon it, I did it myſelf: but as from its ſtiffneſs we found it equally difficult to get the bridle cable unbent from the ſwivel, and the men being much fatigued by the previous operations, it was thought beſt to let all ſtand as it was till day-light.

At

At daylight the 22d, the wind blew very freſh at S. E. ſo that it was with great hazard, that the Edyſtone boat lay alongſide the Buſs to deliver the great buoy on board: this was however done without miſchief; but it then came on ſo very freſh, that it became expedient for the Edyſtone boat to return home for her preſervation; firſt receiving orders to come out again as ſoon as the weather would permit, in caſe we did not follow her. The wind being now equally favourable for carrying in the Buſs, and ſtill increaſing, to ſave time it was agreed to cut the clinch of the bridle cable, and lower down the ground chains by the buoy chain, in the ſame gradual manner in which they were heaved up; and by twelve o'clock we had lowered it twelve fathoms: while this was doing, one of our yawls broke looſe, and before we were aware that it was gone, had driven away too far for us to attempt to recover it.——On driving a bolt through one of the links of the buoy-chain (intended as a ſtop to the *under-water* buoy as before mentioned) we diſcovered a flaw in that link, which, though it did not appear of great conſequence, yet deſerved conſideration, and, if poſſible, amendment: but as no *extempore* remedy, that could there be applied, offered itſelf, and we found the wind had not increaſed ſince morning, and that the Buſs rode very well, as ſhe was then circumſtanced; our ſolicitude that nothing ſhould be left in an exceptionable ſtate, prevailed upon us to abide where we were, till the Edyſtone boat ſhould return, when we might ſend her back for ſomething proper to ſecure that link.——This over-precaution, as the wind was fair, and quite enough for us, coſt us dear; for at three o'clock the wind and ſea had ſo much increaſed, that it became unſafe to ride any longer by the buoy-chain; we therefore had no other alternative, but to launch the large floating buoy, and caſt ourſelves looſe.

143. WE found the Buſs go much better ſince her cleaning; yet the wind having by this time veered to the North of the Eaſt, which was but one point before our beam, and therefore in the common eſtimation of ſailing *fair* for us; we found in ſtretching ſome length on our courſe, that we could not fetch *Plymouth Sound*; and an attempt to make a tack with *our* veſſel, as we before had *proved*, would have been to no purpoſe. We therefore unanimouſly agreed to ſteer away before the wind for *Fowey*; and as it then blew a hard gale and was quite in our favour, we expected to reach our port before it was *dark*; which however we eſteemed of the leſs conſequence, as almoſt every one on board had been there before; and though we muſt expect the night to be dark, this being the day of the new moon, yet the headlands being bold, we concluded ourſelves under no difficulty; inſomuch, that for my own part having been up moſt of the former night, and a good deal fatigued in lending a hand to the forenoon's operations of this day, I went down to my cabin, and as it had been rainy, as well as ſtormy, I diſencumbered myſelf of my wet clothes, intending to repoſe till I heard we were come to an anchor in *Fowey Harbour*.

The perſons on board were, four ſeamen, HILL's company, Mr. JESSOP and myſelf; in all 18 hands. ——For a ſpace of about three hours, I had the ſatisfaction to hear every thing going on well over head; and it was no ſmall addition thereto, when I heard thoſe on deck were altering their courſe, in order to run into the harbour: but ſuddenly an univerſal *alarm* and *clamour* aroſe, inſomuch that I ran upon deck in my ſhirt, it then raining hard, and blowing quite a ſtorm. It being very dark, the firſt thing I ſaw was the horrible appearance of *Breakers*, almoſt ſurrounding us; JOHN BOWDEN, one of the ſeamen, crying out, For God's ſake heave hard at that rope, if you mean to *ſave your lives*. I immediately laid hold of the rope, at which he himſelf was hawling, as well as the other ſeamen, though he was alſo managing the helm; I not only hawled with all my ſtrength, but calling to, and encouraging the workmen to do the ſame thing, in as little time as I have been deſcribing our ſituation, the veſſel's head was brought round, ſo that we no longer faced the breakers, which, from the darkneſs of the night, were almoſt the only objects we could ſee; the veſſel was then heaved down by the ſtreſs of the wind, her gunnel to the water; but as we ſoon found ſhe anſwered her helm, we concluded ſhe was making way. It would require a pen of a different ſort from mine, to deſcribe the jeopardy of our preſent ſituation, while we were uncertain whether or not we ſhould eſcape the rocks, on which the ſeas were breaking with a tremendous noiſe; we had been but a little time in this ſituation before our *Jib* was ſplit to pieces, and to prevent our mainſail * from ſuffering the ſame fate, we were obliged to lower its yard ſo much down the

* It has already been noticed that the Buſs was *Ketch* rigged, that is, with a large ſquare mainſail.

maſt, that the ſail did not preſent above half its ſurface to the wind; yet in this poſition the gunnel of the veſſel was frequently dipped under water. Finding however our veſſel to obey her helm, her head being South by the compaſs, the wind about E. N. E. we began to collect ourſelves ſo far as to conſider what was beſt to be done; ſome ſaying we had overſhot our port; whilſt others alledged that we were ſhort of it: in this uncertainty it appeared to me, that our beſt chance was to ſtand out to ſea, upon the point we then were; which though two points behind the beam (or *large)* we found was as near to the wind as, under the circumſtances we were in, we could make way to advantage. We knew our veſſel would float like a cork upon the water, till ſhe was daſhed to pieces upon the rocks. We could now ſee nothing of land on our lee ſide, yet the extreme darkneſs of the night, rendered ſtill greater by the rain, and the confuſion of the elements produced by the violence of the wind, made it uncertain whether we ſhould be able to ſee the boldeſt ſhore, if of a dark colour, at the diſtance of 50 fathoms. Our danger therefore ſeemed to be that of falling upon the rocks that ſtretch away from *Trewardreth* Bay towards the *Deadman**. In this perilous uncertainty we continued nearly two hours, when having kept upon our point (S.) and meeting nothing, we concluded that we muſt have weathered *Deadman's Point*†; however we had ſtill a violent ſtormy night to contend with, and having ſplit our foreſail alſo, we were now under our mainſail only, and though it was lowered as above deſcribed, yet even ſtill we frequently dipped our gunnel in the water; ſeveral times the ſea broke over us; yet our deck being ſluſh *fore* and *aft*, and our veſſel very buoyant, as before deſcribed, we ſhipped no water.

144. AT daylight on Thurſday the 23d we were out of ſight of land, and having had the laſt of our yawls in tow all the night, in which time ſhe had gradually filled by the ſpray of the ſea (the ſtorm being not at all abated) we found ſhe greatly retarded our way, without any poſſibility of clearing her of water; we agreed therefore to cut her adrift; which indeed nothing but the apparent neceſſity of the thing could have induced us to do, as the yawl might be the means of ſaving our lives, though the Buſs had been loſt: but the neceſſity of this meaſure will appear, when it is conſidered, that in our preſent condition we might poſſibly do better than yield to the violence of the wind, which we found was driving us at a great rate towards the Bay of *Biſcay*. On being freed from the incumbrance of the yawl, we determined to *wear* the veſſel, and make the beſt point we could by ſtanding in for the land; and the veſſel's head was now pointed to N. W.——About noon we got ſight of the coaſt on our weather ſide, which on a nearer approach we judged to be the *Lizard*; and could alſo diſcern land almoſt right ahead. By this time the ſtorm began to abate; we therefore purſued our courſe, and before night perceived that the land we had before ſeen right ahead was the *Land's End*, and that we had been driving ſo much to the leeward of our courſe, that the weſternmoſt point of land we could ſee was now upon our weather bow; we could therefore form no expectation, as the wind then ſtood, of fetching any port of *Great Britain*.——Towards evening it became more moderate, and as we had on board a ſpare fore ſail, a mizen, and a ſtorm jib, we determined to ſet thoſe ſails, put the veſſel about, and make one great effort to beat to windward, and flattered ourſelves that with ſome aſſiſtance from the tide *of Flood*, we might be able to get into *Mount's Bay*.

We ſtood off the land at night, lying as cloſe to the wind as we could make any way, our ſhip's head being about S. E. by E. wind at N. E. At two o'clock on Wedneſday morning we again wore the veſſel, and ſtood on for the land at N. W. by N. which we ſaw ſoon after it was daylight; we ſtood on this courſe till noon, when we found that our veſſel had not altered her ſailing properties; for that, ſo far from having gained any thing to Eaſtward, ſince the preceding day at the ſame hour, we had now got as much to the Weſtward of the *Land's End*, as we were yeſterday of the *Lizard:* the Land's End bearing from us N. E. by N. diſtance by eſtimation eight leagues.——We were now fully convinced, that in this veſſel, as the wind ſtood, we could not make any thing Eaſtward by ſailing: we therefore *lay to* and

* A point of land Eaſt of the *Lizard*. See the general chart, N° 1.

† It has ſince appeared that we had not overſhot our intended port, but had fallen ſhort of it; having got into *Lantippet Bay*, to the Eaſtward of *Looe*: had we really overſhot our port, and got into *Trewardreth* Bay, as then apprehended, we could ſcarcely have eſcaped being wrecked on the rocky ſhore betwixt that and the *Deadman*.

founded,

founded; and finding 40 fathoms water, bottom fine ſand mixed with fragments of ſea-ſhells, we let go an anchor, in order that we might conſider what to do.——The wind though now moderate but freſh, ſeemed invariably fixed to the N. E. we had therefore to conſider, whether we ſhould attempt to croſs the Bay of *Biſcay*, and get into ſome port of *France*, or *Spain*; lie where we were, as long as we could, in expectation of a ſhift of wind in our favour; or endeavour to get into ſome port in the iſlands of *Scilly*.——On muſtering our hands, and our ſtores, we found we had not amongſt us all above a week's proviſions, at ſhort allowance; and this ſeemed inadequate to the attempting to croſs the Bay: for, if the wind ſhould change, when we were almoſt over, we ſhould be obliged, in obedience thereto, to return back again. In ſtaying where we were, we might expend the whole of our proviſions, and at laſt be left to make ſuch ſhift as we could: we therefore were unanimouſly of opinion, that the laſt propoſition, though attended with the moſt immediate *apparent* danger, from the rocks ſaid every where to ſurround thoſe iſlands, yet, as it would put the matter to the ſhorteſt iſſue, was the beſt to be adopted. We therefore reſolved to ſhape our courſe for *Scilly*; but, having neither maps, charts, books, nor inſtruments on board, we could none of us tell (having never been there) what point to ſteer upon from where we were, ſo as with certainty to get within ſight of the iſlands, eſpecially ſhould it come on *foggy* or *hazy* weather.

145. WHILE under this dilemma, we ſaw a ſail to the Eaſt, ſteering directly to us; we therefore made a ſignal of diſtreſs, concluding, that if an enemy, the ſervice we were upon would protect us; yet the ſtate of anxiety we were then in was ſuch, that we would have compounded for being carried to *France* rather than lie there with our preſent proſpects.——The veſſel bore down upon us, and proved to be the *White Hart* of *Pool*, bound for *Guinea*: we told them our ſituation, and ſervice; but we having loſt all our boats, and her's being ſtowed under deck, we could neither of us go on board the other; we learnt from her, however, what ſeemed very material to us to know, that our courſe for Scilly was W. N. W*. We therefore determined to lie there till four o'clock the next morning; that by getting early under way, we might have it daylight by the time we could reach within ſight of the iſlands; and that by having the day before us, we might have the better chance of making ſignals, and obtaining a pilot. ——This evening the wind became more gentle, and at midnight it was a calm.

146. ON Thurſday morning the 25th of November at two o'clock, the hands began to heave in our cable; for, anchoring in 40 fathoms, this was likely to take up ſome time: while it was doing, between three and four o'clock, a gentle breeze ſprung up at N. N. W. The joy and ſatisfaction wherewith this inſpired the whole company, tended greatly to expedite the getting up of our anchor; and by the time it was got to the *Bows*, the breeze was ſo much freſhened at the ſame point, that we did not heſitate in abandoning our propoſed viſit to *Scilly*; and in lieu thereof directed the head of our veſſel towards the *Lizard*.——The place where we anchored is referred to in the general map by the mark ⚓ 40, South-Weſt of the Land's End. As the day came on, the wind ſtill freſhened at the ſame point; and we not only ſet our uſual ſails, but a topſail; and brought out every yard of canvas we could muſter, as well as ſome of our blankets, which we contrived to ſet to ſome advantage as *ſtudding* ſails. Early in the day we paſſed the *Lizard*, and made our courſe good, ſo that at nine in the evening we were abreaſt of the *Deadman*. Soon after midnight we began to get ſight of the *Floating Light*; at four on Friday morning the 26th, we once more eſpied our old acquaintance the *Ram Head*; and at ſix came to an anchor in *Plymouth Sound*; not without thankful hearts for this deliverance, and to the inexpreſſible joy and ſatisfaction of all our friends, who had concluded we had either been caſt away or carried to *France*. And indeed ſuch concluſions were not unreaſonable; for the Edyſtone boat having been ſent out on Wedneſday (which was the firſt day ſhe could look out to ſea) and not finding us, returned with the melancholy tidings; and going out again on Thurſday to make enquiry at the floating light, where they met with a very unſatisfactory account of us, our friends were not without great reaſon alarmed concerning us.

* This was indeed nearly the courſe by the *true meridian*, or rather N. W. by W. Had we therefore ſailed upon a W. N. W. courſe, as directed us, by the *compaſs*, as we then *underſtood it*, we ſhould probably have paſſed by the iſlands without ever ſeeing them.

A few

A few days after, the Buſs was brought into Mill Bay, and laid upon the Beach, near the Jetty Head, that ſhe might be in daily view of thoſe employed in the work-yard.

147. HAVING now completed the relation as to the work of this ſeaſon, I cannot in juſtice avoid paying that tribute to a deſerving poor man that I think due to him.

I found my mind very forcibly ſtruck with the diſtinguiſhed activity and preſence of mind of our ſeaman JOHN BOWDEN, upon the occaſion of our miſſing the harbour of *Fowey*. I was fully convinced that had he not been on board, the Buſs would certainly have gone aſhore, moſt probably been daſhed to pieces upon the rocks, and in the confuſion and darkneſs of the night, ſeveral of us would in all probability have loſt our lives: and therefore that the ſafety of the veſſel, as well as ourſelves, was owing to his expertneſs as a ſeaman. He had on all occaſions ſhewn himſelf to be an active, ſober, modeſt, obedient man; and in the light of a *foremaſt* ſeaman, he appeared to be quite a *Genius*; for, if any thing went wrong with the tackle on board, his readineſs of thought, and invention, accompanied with an expeditiouſneſs in the application of ſomething for ſupplying defects, and remedying, if not preventing, diſaſters, was beyond any thing I had ever had the opportunity of obſerving amongſt others of his claſs; and he was the only ſeaman in that ſtation I have ever met with, who never ſwore an oath, drank a dram, or was ſeen diſordered with liquor of any kind. Had I been an admiral, I could not have done leſs than ſignally have rewarded his ſervices: but though my employers had generouſly left it to me to reward merit wherever I found it, I was obliged to be contented to do on this occaſion what was *properly* in my own power: I therefore put him upon the ſame footing with WILLIAM SMART, who was maſter of the *Edyſtone Boat*, and had long been employed in the ſervice of the Proprietors; paid him the difference of the wages, and emoluments, from the time of his entry; and further promiſed him the command of the firſt veſſel that ſhould be built in addition for our ſervice: which boon I know not whether he had more ſatisfaction in receiving, or I in beſtowing; but I was ſure he could not be better ſatisfied with it, than I was convinced that he deſerved it.

CHAP. III.

Containing the Tranſactions of the WINTER *of* 1756, *and of the following* SPRING 1757, *to the Commencement of the* Outwork *of the enſuing Seaſon.*

148. DURING this period, my operations were ſo numerous, diverſified, and blended together, with reſpect to the time in which the ſeveral tranſactions were performed, that though I ſuppoſe a minute detail thereof was very intereſting and ſatisfactory to the Proprietors at the time they were carried on, yet now ſuch a particular relation would be unworthy of their attention, and much leſs that of the public: for which reaſon I ſhall only recount the leading or moſt intereſting facts, without always regarding the preciſe days on which they were performed; unleſs it ſhould appear proper in ſome inſtances ſo to do.

I have already mentioned, that our work-yard at Mill Bay was ready for the reception of ſtone, and the employment of ſtone-cutters: but though I found that Meſſrs. RICHARDSON and HILL were very well qualified for the *Outwork*, yet as they had been but little uſed to the working of *Portland* ſtone, upon the exact performance of which the *Frame* (if I may ſo call it) of our building depended; I was on that account induced to accept of the ſervices of WILLIAM TYRRELL, who had been one of the maſons concerned in the preparation of the ſtone at *Portland* for *Weſtminſter Bridge*, and who, on the recommendation of Mr. RICHARDSON (on whom I found I could always rely,) offered himſelf as foreman over the ſtone-cutters, and to overlook the works of the yard.

149. THE

149. THE general deſign and contrivance of our *Work-Yard* will appear by Plate N° 17, and the detail will be fully underſtood by the technical explanation of the plate; but to render it ſufficiently intelligible for the preſent, I take this opportunity of explaining the principal properties thereof: and though the plan of a maſon's work-yard may not appear to be a matter of much concern, or ſuſceptible of much invention, yet in our particular caſe, the ſucceſsful carrying on, and expediting of our works, depended more upon a convenient diſpoſition of this, than can readily be imagined.

From the beginning I always laid it down as a *fundamental* maxim, that on account of the precarioufneſs of weather to ſuit our purpoſes, (and without its being favourable, I think it has already ſufficiently appeared, that nothing is to be done upon the Edyſtone) if we could ſave one *Hour*'s work upon the *Rock* by that of a *Week* in our *Work-yard*, this would always prove a valuable purchaſe; and that therefore every thing ought to be done by way of preparation, which could tend to the putting our work together with expedition and certainty, in the ultimate fixing of it in its proper place; and for this purpoſe, it was neceſſary to make uſe of as large and heavy pieces of ſtone as, in ſuch a ſituation as the Edyſtone, were likely to be capable of being managed without running *too great* a riſk.

150. THE common run of modern buildings, even of the largeſt ſize, are compoſed of pieces in general not exceeding five or ſix hundred weight, except where columns, architraves, cornices, and other parts are to be formed that indiſpenſably require large ſingle pieces; becauſe ſtones of this ſize and bulk are capable of being handled without the uſe of *Tackles*, or *Purchaſes*, unleſs where they are to be raiſed perpendicularly: yet it appeared to me, that this choice of general magnitude reſulted only from the workmen's not having commonly attained all that expertneſs in the management of the *mechanic Powers* that they might have; in conſequence of which, they avoid, wherever they can, the neceſſity of employing them. This ariſes not from the real nature of the thing, when properly underſtood; for a ſtone of a ton weight is, when hoiſted by a proper tackle, and power of labourers, as ſoon and as eaſily *ſet* in its place, as one of a quarter of that weight; and in reality, needs much leſs hewing than is neceſſary for the preparation of four ſtones to fill up the ſame ſpace; nor needs this reaſoning ſtop at ſtones of a ton weight, but it might proceed even to as large ſizes as are ſaid to be found in the ruins of *Balbec**; if there were not inconveniences of other kinds to ſet on the oppoſite ſide of the queſtion, as well as the want of quarries in this kingdom to produce ſtones of that magnitude.

151. THE ſize of the ſtones that could be uſed in the Edyſtone Lighthouſe ſeemed limited by the practicability of landing them upon the rock: for as nothing but ſmall veſſels, that were eaſily manageable, could poſſibly deliver their cargoes alongſide of the rock, with any reaſonable proſpect of ſafety; ſo no ſmall veſſels could deliver *very* large ſtones, becauſe the ſudden riſing and falling of the veſſels in the Gut amounted frequently to the difference of three or four feet, even in moderate weather, when it was very practicable for a veſſel to lie there; ſo that in caſe, after a ſtone was raiſed from the floor of the veſſel, her gunnel ſhould take a ſwing, ſo as to *hitch* under the ſtone, one of ſuch a magnitude as we are now ſuppoſing, on the veſſel's riſing, muſt infallibly ſink her; and hence it appeared, that much of the ſafety in delivering the cargoes would depend upon having the ſingle pieces not to exceed ſuch weight, as could be *expeditiouſly* hoiſted, and got out of the way of the veſſel, by a moderate number of hands, and by ſuch ſort of tackles as could be removed from the rock to the ſtore-veſſel each tide: and on a full view of the whole matter, it appeared to me very practicable to land ſuch pieces of ſtone upon the rock, as in general did not much exceed a ton weight; though occaſionally particular pieces might amount to two tons†.

The general ſize of our building ſtones being thus determined upon at a ton weight, thoſe would have been far too heavy to be expeditiouſly transferred and managed, even in the work-yard, unleſs our

* There are three ſtones lying contiguous in the plain part of a wall, that from the meaſures amount together to upwards of 1,500 tons. See WOOD's account of the ruins of *Balbec*. Deſcript. Plate 3d. Page 19.

† In the courſe of the building we have had inſtances of the boat's gunnel hitching under a ſtone in the tackle, and ſo as to unhook it: yet we fortunately never ſuffered any damage by loſing the ſtones, as they always happened to fall from the gunnel into the boat.

machinery rendered that eaſy, which would otherwiſe be difficult, without too great an expence of labour: and as the moving and transferring the pieces of ſtone in the work-yard would be greatly increaſed in quantity, by the very mode of attaining a *certainty* in putting the work together upon the rock; this conſideration made it ſtill the more neceſſary, to be able to load upon a carriage, and move the different pieces from one part of the yard to the other, with as much facility (comparatively ſpeaking) as if they had been ſo many bricks: for, that we might arrive at perfect certainty in putting the work ultimately together in its place upon the rock, it did not appear to be enough, that the ſtones ſhould all be hewn as exactly as poſſible to moulds that fitted each other; but it was further neceſſary, that the ſtones in every courſe ſhould be tried together in their real ſituation in reſpect to each other, and ſo exactly marked, that every ſtone, after the courſe was taken aſunder, could be replaced in the identical poſition in which it lay upon the *Platform*, within the fortieth part of an inch.——Nor was this alone ſufficient; for every courſe muſt not only be tried ſingly together upon the platform, and marked, but it muſt have the courſe next above it put upon it, and marked in the ſame manner, that every two contiguous courſes might fit each other on the *outſide*, and prevent an irregularity in the outline: and this indeed, in effect, amounted to the *platforming* of every courſe twice: ſo that, in this way of working, every ſtone muſt be no leſs than ſix times upon the carriage; 1ſt, When brought into the yard from the ſhip, to carry it to the place of depoſition till wanted to be worked.——2ndly, When taken up and carried to the *Shed* to be worked.——3dly, After being wrought, to be returned to its place of depoſition.——4thly, When taken up to be carried to the platform.——5thly, When finiſhed on the platform to be returned to its place of depoſition.——6thly, When taken up to be carried to the Jetty, to be loaded on board a veſſel to go to ſea.

It might at firſt ſight appear ſuperfluous, to try the courſes together *upon* each other, as the under and upper ſides of all the courſes were planes: and, in caſe the work could have been put together upon the rock in the ſame way that common maſonry generally is done, it would have been ſo: that is, if we could have begun our courſes by ſetting the outſide pieces firſt, then it would have been very practicable to have regulated the inſide pieces thereto; but as our hope of expedition depended upon certainty in every part of our progreſs, this required us to be in a condition to *reſiſt a Storm* at every *Step*: the outſide ſtones therefore, unconnected with the inner ones, would have ſcarce any faſtening beſides their own weight, and would be ſubject to the moſt immediate and greateſt ſhock of the ſea; and after compleating the outward circle, the inner ſpace would be liable to become a receptacle for water: the neceſſity therefore of fixing the center ſtone firſt, as leaſt expoſed to the ſtroke of the ſea, and of having ſure means of attaching all the reſt to it, and to one another, rendered it indiſpenſable that the whole of the *two* courſes ſhould be tried together; that if any defect appeared at the outſide, by an accumulation of errors from the center, it might be rectified upon the platform *.

152. THE ſecond week in December three veſſels arrived from *Portland*, and their cargoes (amounting to about 120 tons) were landed, and ſtowed away in the yard with all poſſible facility; and on Monday the 13th, the maſons firſt began to work the ſtone, under the inſpection of Mr. TYRRELL, who that day entered as foreman of the yard.——I now found there was a likelihood of meeting with difficulties and delays in getting the moorſtone; for having ſome time ſince given courſe XI. to be roughed out by WALTER TRELEVEN, he came to Plymouth to inform me, that he had prepared the ſame, according to the moulds and my directions; but having engaged a maſter of a veſſel to bring it to Ply-

* From a view of Plate N° 17, the reader will perceive that a veſſel to be unloaded of ſtone being laid *athwart* the Jetty Head, a pair of *Purchaſe Blocks* being ſuſpended from the top of the *Shears*, and the tackle *fall* (or running rope) carried to the ſmall *Capſtand* in the yard; the ſtones, being hoiſted ſufficiently high, can be delivered upon the four-wheel carriage that runs along the timber road, commonly called at the *Collieries*, where they are uſed, a *Rail Road*: and being landed upon the carriage, any ſtone can be delivered upon any of the *Bankers* in the line of the work-ſheds on either ſide: or the carriage being turned a quarter round upon the *Turnpike*, or *Turn-rail* at T, it can be carried along the road that goes up the middle of the yard, and be delivered upon any part of its area deſtined for their depoſition; all the ſtones marked for the ſame courſe being depoſited together; from which place they can be again taken up upon the carriage, run along the road, and be delivered upon any *Banker* in the line of ſheds, or upon the *Platform*, and afterwards returned back to the ſame place of depoſition, ready to be carried to ſea in their proper order: the particular modes for the performance of which are explained in the deſcription of this Plate, N° 17.——N. B. A *Banker* in a maſon's yard is a ſquare ſtone of a ſuitable ſize, made uſe of as a work-bench.

mouth

mouth that ſpring tide, he had been diſappointed by him, as he had been twice before by two others; all the three excuſing themſelves from their engagement, on account of the largeneſs of the ſtones, which they alledged were *unmanageable*, the larger ſort of them weighing (to them the aſtoniſhing weight of) *one* Ton! And therefore, unleſs I could myſelf induce ſome perſon to fetch them, they muſt ſtay where they were. Finding nothing but difficulties and diſappointments likely to ariſe from that quarter, I again hired *Hancock's Sloop*, and the next morning diſpatched J. BOWDEN and three other ſeamen, with one of our ſmaller purchaſe tackles, in the ſloop to *Parr*, with which the ſtones were got on board with all imaginable eaſe, and in three days depoſited in our yard; and our moorſtone hands began immediately to work upon them.

153. THE moorſtone, though very hard with reſpect to its component parts, yet being of a friable nature, is extremely difficult to work to an *Ariſs* (or ſharp corner) or even to be preſerved, when ſo wrought by great labour and patience, that is, with ſharp tools, and ſmall blows; it therefore ſoon appeared to me, that we ſhould make very rough and coarſe work of it, if the finiſhing of the pieces were left to the workmen of the country where produced; for, though carefully wrought there in their place, yet in loading and unloading from their carriages, and again putting on board, and unloading from the veſſels, the *Ariſſes* would be very ſubject to damage. Therefore to have as much done in the country as poſſible, and to ſave weight in carriage, (leaving the finiſhing part to be done at home) rough moulds were ſent for each ſize and ſpecies of ſtone, which were to be worked by them to a given parallel thickneſs, and with length and breadth enough, when ſo *bedded*, (as it is called) to be cut round all the ſides to the true figure of the finiſhing mould: but they were to reduce them as near the ſize as they could ſafely do it by the hammer; and that they might not leave on unneceſſary waſte, they were to be paid no more for either ſtone or carriage, than what the *mould* meaſured upon the thickneſs given *; and if they were *wanting* of ſubſtance ſufficient to make the figure compleat, it ſhould be at our option to reject them when they came home.

According to this plan I ſoon after agreed with Mr. Box for 200 tons of moorſtone; 100 tons of which were to be delivered by *May-day* next enſuing, and the remainder in the courſe of the following ſummer, to be laid down in our yard at the price of 20*s.* per ton †, clear of all charges, and 7 *d.* per foot ſuperficial for working the beds as before-mentioned. I alſo agreed with WALTER TRELEVEN for 40 tons of ſtone, conditioned as above, at the price of 25*s.* per ton, cubic meaſure of the moulds, and 4*d.* per foot ſuperficial for working the beds, to be delivered by *May-day* at *Parr*; we undertaking the water-carriage.

There was ſome difference in the price, upon the whole, between the two contractors; but this was the leaſt material part of the conſideration: however as the terms with Mr. Box were not only the loweſt, but his ſtone was leſs friable and better coloured, and would give us no trouble in getting home, it may reaſonably be aſked, why I did not get the whole quantity wanted from Mr. Box? The reaſon was, 100 tons were not ſufficient for the ſervice of the approaching ſeaſon, and he could not undertake for more in due time. I might indeed have made 100 tons ſuffice, could I have been ſure of its delivery; but as accidents and diſappointments might happen, as well to Mr. Box as to Mr. TRELEVEN, it appeared to me, that the way to be ſafe was, to order a quantity from both; beſides, I found, that had I not before given an order to WALTER TRELEVEN, I had not had the offer upon ſo low terms from Mr. BOX; who now plainly ſaw, that if he did not agree with me, the order for the whole would go to his rival.

154. AS ſoon as the works of the yard commenced, I conſtantly viſited them twice a day; and as I laid down all the lines myſelf upon the mould-room floor, I was not without a regular ſeries of daily buſineſs.——It was judged neceſſary, for the ſervice of the next ſeaſon in carrying out our ſtone and materials, immediately to ſet about the building of additional veſſels: the making of proper deſigns therefore for thoſe veſſels, and the ſurveying the conſtruction thereof, with occaſional duty in the yard,

* There was to be no deduction from the contractor, on account of the contracted *waiſts* of the moulds.

† The ton was to meaſure 14 cubic feet.

furniſhed

furniſhed a fixed employment alſo to Mr. JESSOP.——It has been already obſerved, that it was wholly impracticable to carry veſſels of any conſiderable burthen into the *Gut* to deliver their cargoes; it therefore appeared, that our ſervice would be beſt performed by multiplying ſmall veſſels, of ſuch a ſize as to be tractable when lying to unload therein, and which could readily be hauled in and out by a ſmall number of hands. It appeared alſo impracticable to make uſe of veſſels decked over the hold, where the ſtone was to lie; for any thing being in the way of their riſing would be ſubject to hitch upon the ſtone, ſo as to occaſion the breakage of the tackle, and the fall of the ſtone; ſo that in this view, they would require particular dimenſions and conſtructions.

It appeared, however, that we might make uſe of veſſels ſomewhat larger than the Edyſtone boat, which was about 12 tons; but we judged 16, or at the utmoſt 18 tons, was as large a veſſel as could well be managed in the Gut. Mr. JESSOP judiciouſly adviſed their being built unuſually *bold* in their *Bows*, and to have a ſufficiency of height, or depth, to render them very *floaty* and lively in a rough hollow ſea; though by this mode of conſtruction they might not be ſo ſpeedy ſailers. It alſo appeared, that as there could be no taking in of ballaſt, when they had delivered their cargo at the Edyſtone, they muſt neceſſarily always be in ſailing *trim*; and conſequently, that the neceſſary tonnage of the ballaſt muſt be ſo much to be ſubtracted from the whole burthen of the veſſels, the remainder only being the tonnage of materials that could be put on board them. But this was not to be the only deduction from their whole burthen; for we judged it would much contribute to the general ſafety, not to load them more than within one-fourth or one-fifth of their full capacity, which would not only render them buoyant upon the water, but be a ſufficient allowance for an occaſional addition by carrying other building materials, as alſo the companies.

To form ſome eſtimate therefore of what we ſhould want; ſuppoſe from the whole burthen of 18 tons, we deduct four tons for ballaſt, and allow each veſſel to be four tons underloaded, then an 18 ton veſſel would carry a cargo of ten tons. How many of theſe veſſels we might probably want, was determined as follows:——We could not expect in the approaching year to get the building higher than the completion of the *entire* ſolid; and as the plan of every part thereof was already fixed, we could eaſily determine, that the tonnage of this part of the work would be about 450 tons. Now ſuppoſing our working ſeaſon to be, the months of *June*, *July*, *Auguſt*, and *September*, and that during this ſeaſon, we could at an average operate with full effect for two days in the week; then in this ſpace we might expect 35 working days, and this would amount to about 13 tons that ſhould be carried out per day.——The Edyſtone boat's burthen being about 12 tons; admit her to carry three tons of ballaſt, and to be three tons light, then her cargo would be ſix tons, which, with a new boat's cargo of ten tons, would make 16 tons, that is, three tons more than the quantity required: but as things of this hazardous nature ſeldom come up to calculation; as here is too little to make up deficiencies, or poſſibly *the loſs of a boat*, we judged it requiſite, in order to guard againſt accidents, that two new boats of 18 tons each, ſhould be built.

155. IN regard to our *Yawls*, having loſt them all, the experience of the laſt ſeaſon taught us what we ſhould want, and what beſt anſwered our ſervice; and having now not only the opportunity, but time alſo, we provided ourſelves accordingly. We much regretted the loſs of our original large yawl, which was of Mr. JESSOP's providing, while I was laſt in London; as it completely anſwered the ſervice for which it was built: but being too large, and too heavy, to get upon the deck of the Buſs after every tide's work, we were obliged to let it lie at her ſtern, and in the hard gale of the 13th of October, it gradually filled by the broken ſeas driving into it; and there being at that time far too much ſea to haul it up and clear it of water, it became by degrees heavier and heavier, and at laſt broke the *Painter* *, and went adrift as before-mentioned.——The yawl that we loſt in the laſt ſtorm, when we were driven out of the Channel, was one procured from *Deal*, which place is famous for the building of this kind of boats, both for lightneſs and ability to bear the ſea: this boat, when not in uſe, was commonly hawled upon the deck of the Buſs, but as in our paſſage from the Edyſtone to Fowey, we were almoſt right before the

* The name given to the rope which is faſtened to the *Stem* of a boat, and by which it is either detained or hauled in.

wind,

wind, the getting her on deck, while we were thus ſailing, was thought unneceſſary, as we ſhould immediately have wanted her in the harbour: and afterwards it became impracticable.

As there was now upon ſale a veſſel and her equipments, in different lots, we purchaſed her long boat, being a ſtout broad boat, much of the ſize and model of the great yawl we had loſt, and which would anſwer for her *occaſional* ſervice; we called her the *Sea Horſe* yawl from the name of the ſhip to which ſhe had belonged. However, as we ſaw very plainly that we ſhould be frequently loſing our boats on the out-ſervice, unleſs we could take them all on board the Buſs, we determined to build two light yawls, of ſuch ſize and conſtruction, as that both might be ſtowed upon the deck of the Buſs at once, and alſo to build them at home; becauſe, though for want of time, Mr. JESSOP had ordered the former light yawl from *Deal*, and ſent the builders there the dimenſions and ſort of veſſel; yet they confiding that their experience in this branch needed no directions from any one, ſent us a boat much about our ſize, and ſufficiently light, but conſiderably narrower in proportion to her length, as well as ſharper both before and *aft*: which though perhaps better adapted for rowing in *moderately* rough water, (and which doubtleſs would anſwer very well at *Deal*) yet was not ſo well adapted to the hollow diſtracted ſeas that are frequently encountered among the Edyſtone Rocks, as we evidently found the bold full-breaſted boats to be. As all the veſſels built by Mr. JESSOP's directions fully and completely anſwered their intentions in our ſervice, I am ſorry that I have it not in my power, for the ſake of thoſe, who may happen to have a work to perform in *rough Seas*, to give the delineations of them; for though the deſigns were regularly made out by Mr. JESSOP, yet by being worn out in the builders hands whilſt they were in uſe, they were not preſerved; I happen however to have by me the original draught for one of the ſmaller yawls that Mr. JESSOP produced to me for my approbation, and Plate N° 15, contains a tracing thereof from his own drawing, which will indeed ſerve for every ſize of *Yawl*, by altering the ſcale; but our large boats for carrying out the ſtone, though much of the ſame kind of mould, were conſiderably deeper in proportion. The figure of the boat repreſented as lying in the Gut delivering her cargo, Plate N° 14, though only ſketched from memory, yet may ſerve to give ſome idea of what they were, eſpecially if attention be given to the real deſign of the yawl, Plate N° 15. The principle of all our veſſels, as far as they differed from common ones, was, that they were conſiderably broader in proportion to their length, and remarkably full in their bows; which, though not adapted to make way ſwiftly through ſmooth water, yet enabled them to float much more *lively* upon the ſurface, when a ſharper veſſel would almoſt bury itſelf in the water; they were therefore not only ſafer, but even made better *Way* in a rough ſea.——Accordingly, one of the large boats of 18 tons, and a light yawl were immediately put in hand.

156. IN this reſpite from ſea operations, I ſeriouſly began to conſider the great importance that it was likely to be of to our work, to have a *Cement* the moſt perfect that was poſſible, to reſiſt the extreme violence of the ſea. And on a conſideration of this matter, it appeared, that nothing of the reſinous, or oily kind, could have any place in our work, as it would require the ſurface to be *dry*, to enable it to make a compleat adheſion; whereas the getting any thing *compleatly dry*, was one of our greateſt difficulties. It ſeemed therefore that nothing in the way of Cement would anſwer our end, but what would adhere to a moiſt ſurface, and become *hard*, without ever becoming compleatly *dry*.

157. I began now to foreſee that before I could have a compleat ſample produced of every part of the work, that might be wanted for the operations of next ſeaſon, it would be pretty far advanced in the ſpring; and as I propoſed beginning the outwork as early in the ſeaſon as poſſible, I determined to winter at Plymouth (*without* returning to my reſidence in London, as I had before intended) though to the detriment of my own private concerns; laying every conſideration aſide in favour of the Edyſtone. I therefore reſolved to take every opportunity in the evenings and intervals of my attendance on the work-yard, mould-room, &c. to go through a compleat ſet of experiments on *Cements*, ſo far as it concerned the ſubject I had in hand: for I plainly ſaw from the manner of working the moorſtone, already deſcribed, that not only much of the beauty and neatneſs of the work, but its real ſolidity too, would depend upon getting a Cement that would, in deſpite of water almoſt continually driven againſt it with every

degree of violence, become of ſo firm a conſiſtence in itſelf, and adheſion to the ſtone, that it ſhould lie fair and *fluſh* in the joints, and ſo as to compoſe one even regular ſurface with the ſtone; and without needing *Hoops* of *Iron* or *Copper* to ſurround the horizontal joints, as ſeems to have been the expedient of Mr. WINSTANLEY. I was ſo fortunate as to ſucceed in this part of the buſineſs entirely to my ſatisfaction; and perhaps in a degree unknown before: and having made much uſe ſince of the experience which I then acquired; having had frequent occaſions and opportunities of communicating it to others; and having been aſked many queſtions concerning it; I truſt that my reader will forgive me, if I am diffuſe enough to enter into a full explanation of the ſubject, ſo far as I know it. I mean not however to tire him with recording all the particular experiments, as this would be almoſt endleſs, they having been purſued through the whole of this winter; but only to ſtate the principal ſcope and deſign of them, with the reſults: nor do I propoſe to enter into a chemical diſquiſition upon them, which I leave to the learned in that ſcience. But as what I have to ſay on this ſubject will carry me to ſome length, I ſhall reſerve it to a diſtinct chapter, in order to keep the matter together.

158. EARLY this ſpring I thought it expedient to make a journey to the Weſt, not only to ſurvey the moorſtone works that were then going on, but to acquaint myſelf with *Mount's Bay*, in caſe we ſhould have a future occaſion to take refuge there.——I muſt however premiſe, that on the 25th of January, in returning from *Mill Bay* at five o'clock in the evening, I obſerved four flaſhes of lightning towards the Weſt, within the ſpace of ſix or ſeven minutes, but heard no noiſe of thunder. A few days after, I was informed, that the ſame evening the lightning had ſhattered the church of *Loſtwithiel*, in a very ſurprizing manner: and though from the many relations I had read, I could not doubt, but that the effects of lightning were very great; yet as this was the firſt opportunity that had occurred to me of ſeeing them with my own eyes, I was very ſolicitous not to loſe the opportunity. I therefore on this journey called to viſit this church, not only as an object of curioſity, but as a matter very intereſting to my own work; and I communicated a particular account of theſe effects to the ROYAL SOCIETY, which, as it ſtands recorded in the 50th volume of the *Philoſophical Tranſactions*, for the year 1757, page 198, I ſhall take no further notice of here, than as it immediately applies to the ſubject I am upon.

The ſteeple of the church of *Loſtwithiel* before this accident was 113 feet high, whereof the lower part was a ſquare tower of 49 feet, finiſhed above with an elegant Gothic octagon lantern, 12 feet high, and above it a ſtone ſpire of 52 feet, of which a portion of 20 feet of the upper part was entirely burſt, and diſperſed in all directions; and ſome of the ſtones that compoſed it were found at the diſtance of 200 yards.——The maſonry, as is uſual in ancient and well-built ſpires, was very light, the ſtones compoſing the ſhell of it being no more than ſeven inches thick; ſo that the ſingle ſtones of it could not in general exceed one hundred weight: yet as they were all curiouſly joined together at the ends, *mortoiſe* and *tenon* faſhion, and appeared to have been exceedingly well cemented together, nothing, as it ſhould ſeem, but a great power of ſome elaſtic vapour, ſimilar to the ſudden exploſion of a conſiderable quantity of gunpowder, could have burſt and diſperſed the materials of the ſpire in the manner it had done: for beſides the part entirely deſtroyed, to ſix feet further down, one half of the ſhell was thrown down, and the other half left ſtanding, in ſo perilous a ſtate, that it was judged neceſſary to take it down; and on doing this, the work was found ſo diſjointed and ſhattered, that it was thought neceſſary to take down ſix feet more. It was in this ſituation when I viewed it, the beginning of March; and I found that the whole of the ſpire left ſtanding, as well as the lantern, was greatly cracked, and damaged. Many other circumſtances occurred which ſhewed the effects of an elaſtic vapour, that wanted to get at liberty by expanſion, ſomewhat ſimilar in its moſt obvious effects to that of gunpowder; and under this idea, I might have been tempted to ſuppoſe, that had the ſhell of the ſpire been rendered ſtronger by cramping the ſtones together, as well as *tenoning* the ends, it might have ſuſtained the elaſtic preſſure outwards, without being torn to pieces: but there were ſome attending circumſtances which convinced me, that the action had not been altogether in the way of an included elaſtic vapour, endeavouring to expand itſelf; upon which principle, the *weakeſt part* would have given way, and have afforded an opening to the vapour: for, at the bottom of the ſteeple, at the level of the ground, an hole had been pierced entirely through the wall, and through an

oppoſite

oppoſite buttreſs, whoſe compound thickneſs amounted to eight feet; whereas at the diſtance of a foot ſideway it might have got through by piercing the wall alone, which was not more than five feet thick.—— This circumſtance, beyond all the devaſtation that had been made, both in the ſteeple and the body of the church, convinced me, that there could be no certainty of making any wall ſo ſtrong as to withſtand the action of *Lightning*; and conſequently that no ſecurity againſt the effects of it, that human ſagacity had either diſcovered, or could ſuggeſt, ought to be omitted in any building of conſequence. Therefore, however ſtrongly I was diſpoſed, before I ſaw this example, to adopt the propoſition of *Dr.* (then Mr.) FRANKLIN, for the preſervation of buildings from the effects of lightning by means of a *Conductor* (which had had not at that time become popular) this inſtance applied itſelf ſo cloſely to my feelings, that I determined to put his method in practice in my propoſed building, in the beſt manner I was able: and the particular mode in which this was done, will be fully explained when we come to that period of the building.

159. DURING the time the experiments on Cement were making, and the works of the yard proceeding vigorouſly, I was very deſirous to find an opportunity of going upon the rock to compleat our moulds for the foundation courſes; but it was very ſeldom at that time of the year that the weather, even in appearance, was promiſing. However, Wedneſday January the 12th, there having been ſome days of froſt, with moderate breezes, this morning the water in Plymouth Sound was very ſmooth, and I went on board the Edyſtone boat with Mr. JESSOP and the mould-maker, the Sea-Horſe yawl attending. All continued promiſing till we got out of the Sound, but without the Ram Head we met with a ſwell from the South, which increaſed as we came nearer the Edyſtone, ſo that when we came there, we found the ſea beating over it with great violence at low water: we ran within twice our boat's length of it, on the Weſt ſide, to have a view of the work, in which we could not perceive any injury from the late ſtorms, nor change, except that the new ſurface was of the ſame colour as the old; being all grown over with dark coloured green ſea-weed. We alſo ran alongſide our buoy upon the moorings, and had the great ſatisfaction to find it floating, and in good order.

We made ſeveral expeditions of the ſame nature in the courſe of the ſpring, and with no better ſucceſs; ſo that it was not till the 23d of April that we got a landing. We then went out in our firſt new boat, which was launched on the 22d of March, and was called the *Weſton*, JOHN BOWDEN, maſter. There being little wind, we were obliged to row almoſt all the way. Between twelve and one, when we were now about a league from the rock, it became calm; and as we were not ſoon likely to get out with the great boat, we betook ourſelves to the Sea-Horſe yawl which attended us, and in an hour landed, and got a tide's work of four hours; in which time having marked a durable middle line upon the rock, we got the moulds compleated for courſes I. II. and VI. except that a right line was wanted to be drawn upon them, to enable us to join them together again on ſhore, in the ſame poſition exactly in which they lay upon the rock; and for this particular uſe a ruler had been provided, which being too long to carry in the yawl, was left on board the *Weſton*, to be brought forward by her: but as ſhe did not arrive at the moorings till we were obliged to quit the rock, this was a ſenſible diſappointment; however it did not prevent us from compleating for uſe the courſes we had framed: for, by ſtretching a piece of packthread over the moulds, we were enabled to bore two ſmall holes in every piece; ſo that when the parts of the moulds were laid together in contact upon a level floor, and thoſe holes brought into a right line, they would then be in the ſame poſition as they were upon the rock.——As it remained calm, we determined to ſtay in the Weſton all night, but, on examination, finding the carpenter had neglected to bring off an additional paper of nails that he was expreſsly ordered to bring, and *reminded* of, this trifling incident, however ſmall in itſelf, was yet likely to put a ſtop to our farther proceedings; for not being able to form any expedient to do without the nails, the carpenter and three ſeamen were diſpatched in the yawl for Plymouth to bring out this neceſſary article. The weather continued calm all the night, but in the morning it began to blow freſh at S. which brought on a ſwell; and not only prevented us from landing, but obliged us to return to Plymouth.——Upon the 30th, we got a very good landing

landing in the yawl, and had the good fortune to compleat the whole of the moulds that were wanting, juſt in time to quit the rock when the wind and ſea would very ſoon afterwards have obliged us to do ſo.

160. THE accompliſhment of theſe moulds, (an object much deſired ever ſince the concluſion of the laſt year's work) having been thus happily effected, after much delay, diſappointment, and danger; the next thing was to procure a room, upon the floor of which we could lay them together, and, by laying down chalk lines, form the reſt of the pieces that were wanted to make up each courſe, to which they formed, as it were, the *Roots*. This requiring a larger room than any we had at our command, I applied to the Mayor of Plymouth for the uſe of the floor of the *Guildhall:* and I am very ſure the preſent magiſtrates will bluſh for their predeceſſor, when they are told that his Worſhip had ſo little feeling, or attention to the public ſervice, that I was abſolutely refuſed, on pretence that the chalk lines would ſpoil the floor. I afterwards applied for the *Aſſembly Room*, but there I ſucceeded no better. Theſe unexpected rubs were not however inſuperable; for by removing a partition between two rooms, which were the garrets of our cooper, I got a floor large enough to hold each courſe at *twice*; and to this, though attended with a conſiderable addition of trouble, yet as it would only occur in the third, fourth, fifth, and ſixth courſes, I determined to ſubmit, rather than ſubject myſelf to any more Denials.

161. IN conſidering at leiſure the various impediments to which our work was liable, it behoved us to endeavour to remove every thing of that ſort poſſible. Though our predeceſſors, to prevent annoyance from an enemy, had a veſſel of war upon the ſtation to protect the workmen, yet the generous behaviour of the *French King* on a former occaſion, (mentioned § 51,) gave us aſſurance that we ſhould have nothing to fear from the enemies of the ſtate. But yet we had experienced, during the courſe of the laſt ſeaſon, a good deal of hindrance and interruption from our *Friends*; for our boats were frequently ſtopped and boarded by the men of war's cutters, to impreſs the ſeamen; and notwithſtanding they were furniſhed with *Admiralty* protections, yet there occurred ſome inſtances of the officers being ſo indiſcreet as to pay no regard either to the protections, or the ſervice they were upon. And though our men were always releaſed with politeneſs, when the matter was repreſented to the *Commander in Chief*, yet all this produced delays and hindrances incompatible with the urgency of our buſineſs. And as it plainly appeared, that nobody would moleſt us, provided it could be made clearly to appear, without colluſion, that our men were really and *bonâ fide* employed in the Edyſtone ſervice, it occurred to me, that if a large figure of the Lighthouſe was painted upon the mainſail of our boats, it would be an evident mark of diſtinction at a diſtance, and prevent their being ſtopped. But yet, that after all, the ſeamen, when on ſhore, would ſtill be liable to be detained, when abſent from their boats. To prevent this, I conſidered, that if I had a ſtamp, which could not readily be counterfeited, with which one might at pleaſure ſtamp a piece of ſilver, each man employed by us might thus be furniſhed with an evident token in his pocket of the ſervice to which he belonged. This idea having been communicated to Mr. WESTON, he ſoon got a ſufficient number of ſilver medals made for the purpoſe, of which Fig. 7, Plate N° 18, is the repreſentation: and after the diſtribution of theſe, and the painting of the ſails, we never had any further interruption.

162. A HINDRANCE of another kind however aroſe; for about the middle of February, we had advice from Mr. TUCKER, that the frequent appearance of French privateers had intimidated the maſters of the Portland veſſels ſo much, that they were afraid to ſtir out: and this gave me the more ſolicitude, as all the ſtone we had received from Portland was then nearly worked up. On communicating this, Mr. WESTON immediately applied to the *Lords* of the ADMIRALTY, who diſpatched an order to the commander in chief at *Portſmouth*, to ſend a convoy upon notice from Mr. TUCKER, of any veſſel being ready to ſail that was freighted with ſtone for the *Edyſtone*. However, before any convoy was ſent, two veſſels thought good to *run it*; and arrived with a freſh ſupply of ſtone from Portland the 8th of March, and carried back to Portland the moulds for all the ſtone that could poſſibly be wanted in the courſe of the enſuing Summer.

163. AS

163. AS we had been for ſeveral days without any unwrought ſtone in the yard; the maſons were employed in detaching ſufficient pieces from the neighbouring marble rocks, and forming out of them cubes of one foot each ſide, for inlaying between the different courſes; as will be more particularly deſcribed hereafter in its proper place: and the labouring tinners were employed in drilling a couple of holes through the outward end of every ſingle ſtone; by which they were intended to be *trenailed* down to the courſe below. For, though I could not eaſily conceive, when each block was fixed in its place, by oak wedges in the dovetail ſpace cut out of the rock, or furniſhed by the work already fixed, that any thing could move it; yet, conſidering the unmeaſured violence of the ſea, I determined to omit nothing that could tend to keep the whole firm together, while the cement was freſh and unhardened; as that ſeemed the beſt way to prevent derangements and diſappointments, while things were going on: and ſoon after, we purchaſed 300 *trenails*, of the beſt quality, and the ſame ſize that I underſtood was uſed in building the firſt rate men of war; being 2½ feet long, and two inches ſquare, in the rough.

164. IN carrying on a work of this ſort, I have always found it more difficult to manage the workmen employed, than to controul the elements. High wages and encouragements may have the effect of *inducing* men, in caſes where they cannot be *compelled*, to enter into ſuch ſervices, which no other kind of perſuaſion would be able to accompliſh.——This mode, however, by no means teaches them *Submiſſion* and *Obedience*; on the contrary, it leads them to ſuppoſe that every ſucceſs, in the operations they have been concerned in, is owing to their own perſonal merit and addreſs; and that, had they not been employed, the thing could not have been done by any other perſons: of this I had ſeveral examples in the courſe of the outworks of the laſt ſeaſon; having diſcovered a ſtrong tendency to *Mutiny* and *Combination*. ——WILLIAM HILL, though as a foreman he received one ſhilling per hour *extra* pay, and had in one week of the preceding ſeaſon intitled himſelf to the receipt of near *five Guineas*, (including his conſtant wages,) yet this by no means increaſed his *gratitude* for being taken into the employ, or his attachment to the ſervice. In ſhort, having found him irregular and diſorderly, and privately a ſower of diſcord among the workmen; and having always in ſuch caſes experienced it to be the moſt effectual method to lay the axe to the root of the tree; I diſcharged him the ſervice for *diſobedience of Orders*, as an example to leſs offenders.——This tranſaction being upon a Saturday, on Monday following, HILL came into the yard to fetch away his tools, and claimed the fulfilling of their promiſe of all thoſe who had worked with him upon the rock; which was, "that if *he ſhould be diſcharged they would all follow him.*" Upon this I inſtantly called them together, and deſired that whoever had any dependance upon, or attachment to, WILLIAM HILL, would take away his tools and depart the yard immediately; which one of the moor-ſtone maſons did, all the reſt prudently chuſing to ſtay where they were.

165. THIS tranſaction gave an opening to rectify what I had plainly perceived to be an evil to the ſervice of the *Outwork*; that is, that the *Premiums* with reſpect to the inferior workmen were not only too near that of the foremen, but in reality higher than neceſſary to countervail the riſk, in their own *Opinions*: and indeed every encouragement *more* than that tended only, as we have ſeen, to make the men diſorderly and untractable: wherefore after conſideration, the following Saturday I called together in the yard all the workmen that ſerved upon the rock during the laſt ſeaſon, and repreſented to them, that in proportion as the houſe was raiſed, the number of hours they would have opportunity of working thereon would increaſe, and the work become eaſier and leſs hazardous; and that therefore they *ought* not to expect the ſame *premium* by the hour, the enſuing year, that they had had the laſt year; and that in conſequence I intended to ſettle ſuch a price at the beginning of the work of this ſeaſon, as I propoſed to hold to till we could make a *lodgement* thereon; for then, they would be able to make regular days works; and that the price I ſhould now fix would be ſix-pence per hour for the maſons and carpenter, and four pence per hour for the tinners; their weekly wages to be the ſame as laſt year: and under theſe conditions every individual might take his choice, either of working conſtantly in the yard, or of going off to the rock by rotation every other week. Whereupon every one without heſitation declared his readineſs to ſerve upon the rock, upon the terms offered: an event which gave me particular ſatisfaction, as it was

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not only be a conſiderable ſaving to the proprietors, but the work itſelf would be quite as well and expeditiouſly done. And, though it is not an eaſy matter to *reduce* emoluments, with the *Conſent* of parties; yet I have always found amongſt mechanical artificers, as I ſuppoſe it is with other denominations of men; that firmneſs, juſtice, equality, and a *fair alternative*, will always carry the point.

166. IN the month of May I received a letter from Mr. TUCKER, importing that in conſequence of the ADMIRALTY's order, he had ſometime ago applied to the *Commanding Officer* of the *Fleet* at *Portſmouth*, to have a convoy for the *Edyſtone* materials to *Plymouth*; that he had regularly got an anſwer from the commanding officer, that a convoy ſhould be ſent; but that no convoy *had come*. This was repeated, and anſwers regularly received; but the fact was, that no convoy did ever attend this duty: ſo that the favourable ſentiments which the *Lords* of the ADMIRALTY, and their principal commander had of the importance of our work were yet defeated; as it happened not to appear in that light to thoſe who were appointed to the ſervice: ſo that we remained equally unſerved, as if we had never had any order of aſſiſtance. Doubtleſs on proper repreſentation, this neglect would have been duly adverted to; but as the delays, before they amounted to a matter of complaint, had been ſuch, as to oblige us to run *all riſks*; and nothing in reality had happened adverſe; we thought it unneceſſary to trouble the Admiralty for a kind of redreſs that could *then* no ways conduce to the *re-erection* of the Edyſtone Lighthouſe.

167. IN the courſe of the month of May we received from London five fathoms of additional main chain propoſed to be added to the ſix fathoms that already acted as a bridle, which, as it would make us eleven fathoms of bridle chain, and this was more than half the depth of the water at the place of our mooring, would prevent the neceſſity of lifting ſo conſiderable a part of the ground chains from the bottom in mooring or unmooring, and thereby prevent a loſs of time, that might in effect prove conſiderable: for in many caſes we had ſeen, that the want of an hour, to the accompliſhment of ſuch points of our buſineſs, as depended upon winds and ſeas, might prove a delay of weeks, which might ultimately occaſion the loſs of a ſeaſon in the finiſhing of the building.——Theſe neceſſary preparations having been made, and a quantity of *Plaſter* received, ready prepared for uſe in London, and cloſe rammed into five caſks, to prevent the bad effects of the air upon it; we were now ready for commencing the operations upon the rock as ſoon as the ſeaſon would give us room to ſuppoſe we were likely to have ſucceſs in carrying them on: but previouſly to my relation of the works of the approaching ſeaſon, I ſhall now perform my promiſe of giving an account of my experiments and obſervations reſpecting the *Cement* we uſed, which was referred to a ſeparate chapter.

CHAP. IV.

Containing EXPERIMENTS, *to aſcertain a compleat Compoſition for* WATER CEMENTS; *with their Reſults.*

168. ON this ſubject, I was already apprized that two meaſures of quenched or ſlaked lime, in the dry powder, mixed with one meaſure of *Dutch Tarras*, and both very well beat together to the conſiſtence of a paſte, uſing as little water as poſſible, was the common compoſition, generally uſed in the conſtruction of the beſt water-works both in ſtone and brick; and which, after being *once ſet**, would afterwards become hard, without ever being compleatly dry; nay, that it would in time grow hard, even *under* water. This therefore ſeemed to be the kind of cement adapted to our uſe; and what

* This is the term uſed in the application of calcareous mortar, which denotes its firſt ſtep, or degree of hardening; but in this ſtate, though it has loſt its ductility, it is a very friable ſubſtance.

I had

I had yet to learn, was, the beſt materials, and mode of treating and uſing them. I was ignorant at this time, whether there would be any difference in the firmneſs of the mortar, on account of the lime being made from different kinds of lime-ſtone, provided the proportion of the ingredients was ſuitable. I found it indeed commonly aſſerted by *Maſons*, that the harder or ſtronger the *Lime*-ſtone was, the ſtronger would be the *Lime*; but whether this maxim chiefly regarded the uſual compoſition of lime and ſand in common buildings (with which they were chiefly acquainted) or whether it held good alſo in *Tarras Mortar*, did not appear.——It was alſo generally agreed by maſons, that mortar, if mixed up with ſalt water, would never harden in ſo great a degree, as the ſame kind of compoſition would do if made with freſh water.——I could readily conceive, that if mortar was mixed with ſalt-water, and uſed for the plaſtering, or even the walling, of a dwelling-houſe, the wall ſo built would never become ſo perfectly dry, but that when the atmoſphere was in a humid ſtate, the ſea ſalts, by this means conveyed into the compoſition of the mortar, would attract the moiſture of the air, and render the wall viſibly and palpably moiſt: Nay I have been told, that if a houſe be covered with plaſter which has ſea ſand in its compoſition, though it is mixed up with freſh water, or even if ſea ſand is made uſe of in the joints of the walls, it will ſhew its affection to moiſture in very damp weather, and the plaſter over thoſe joints will become evidently diſcoloured. But as it appeared to me, that in the caſe of *Tarras* mortar, *drying* and *hardening* were diſtinct properties, not evidently dependant on each other; it might be, that though *Tarras* mortar made up with ſalt-water, might equally diſcover its ſenſibility of moiſture, if uſed for the *ſame purpoſe*, as common mortar made up with ſand only; yet this circumſtance might not impair its hardneſs, or *firmneſs* of *Adheſion*, where perfect dryneſs was not wanted; conſequently it would be no injury, in the ſubject of *Water Building:* and as the neceſſity of carrying out, or not, from the land all the water we ſhould have occaſion for in this building, was a matter of moment, the full inveſtigation of this queſtion became very material.

169. THE firſt object of enquiry, as I had heard much complaint from the workmen, of limes not being *well* burnt, was, whether good or bad burning affected the *Quality*, or the *Quantity* of the lime produced from a given quantity of ſtone, or both? Therefore, in my firſt eſſays, I did this part of the buſineſs myſelf; the reſult, as it then appeared to me, was, that if the ſtone was not expoſed to a certain degree and duration of fire, according to its original hardneſs and compactneſs, it remained ſtone, without becoming lime; or was converted into lime to a certain depth from the outſide only, the parts near the center remaining ſtone: the diſtinction between *Lime* and *Lime-ſtone* being (ſo far as I have had occaſion to enquire into it) that lime-ſtone, after it has been expoſed to a ſufficient degree of fire, will, on throwing water upon it when in large heaps, or plunging a ſingle lump into water, and quickly drawing it out again, become hot, ſmoke, and ſwell ſo as to be reſolved into a dry impalpable powder, in which ſtate it is called *ſlaked Lime*; I ſuppoſe, to diſtinguiſh it from that ſoft, moiſt, earthy ſubſtance, which it becomes on ſuch a further addition of water, as muſt be uſed to prepare it for making mortar. Now if the lime-ſtone is imperfectly burnt, it only in part falls into ſlaked lime; the reſidue not being capable of being reduced to that kind of mealy powder, which, with a further addition of water, and a little beating, becomes a tough kind of paſte; and which is capable of firmly uniting into one maſs, with any kind of hard, ſandy, or gritty matter, that may be introduced as a mixture with it, in the compoſition of mortar for maſonry: whereas, the part that will not ſo fall down, inſtead of a ſoft paſty ſubſtance, becomes in general rather more rigid and hard by the addition of water.

I therefore tried a quantity of powder-lime that had fallen from a ſtone imperfectly burnt, and an equal quantity of lime from one that was thoroughly burnt; and having in other reſpects treated them in the ſame manner, both with ſalt water and freſh, I found the former to work ſomewhat more harſh, but that ultimately there was no material difference in the quality of the mortar: and from hence I formed this concluſion, that the complaints of workmen on this head were rather founded upon the *great waſte*, and *ſmall produce*, from imperfectly burnt lime, than from a real difference in the quality of what is produced. It is however to be noted, that I took none of the ſlaked lime, that was produced from the imperfectly burnt ſtone, but what would paſs the *fineſt* ſieve; becauſe I conceived, that

a degree

a degree of burning may be ſo much in the confines of what is enough, and what is not enough, as that the ſtone may fall to ſuch a degree of fineneſs as to paſs a coarſer ſieve, and yet not fall to that impalpable powder neceſſary to form a compleat paſte. For though, when paſſed through a coarſer ſieve, there may be enough of the finer parts to form a paſte, yet in this way a comparative experiment would be rendered inconcluſive, becauſe the ſmall parts of unburnt ſtone muſt be conſidered as ſo much admixture of *Sand*, or gritty matter, and this at leaſt alters the intended proportion between the quick-lime and the groſs matter. The reſult of this experiment however, though it ſhews that the uſe of imperfectly burnt lime is not only waſteful, but in every ſenſe of it ineligible, when applied to a work in large; yet it ſufficiently ſecured me in the courſe of my experiments, from any doubts that might be formed, of the reſults of ſuch as were made with ſlaked lime, which was neither of my own burning, nor of my own quenching; becauſe it was always eaſy to get enough paſſed through the *fineſt ſieve*, for the purpoſe of an experiment, though it might prove impracticable to get enough ſo paſſed to anſwer the demands of a real building*.

170. BEFORE I proceed any further, it will be neceſſary to explain the mode in which I compounded, and made up my mortar for trials. I took as much of the ingredients, as all together would ultimately form a ball of about two inches diameter.——This ball, lying upon a plate till it was ſet and would not yield to the preſſure of the fingers, was then put into a flat pot filled with water, ſo as to be covered by the water; and what happened to the ball in this ſtate, was the *criterion* by which I judged of the validity of the compoſition for our purpoſes.——The meaſure I uſed was a common ſmall chip box, taking as many meaſures from each ingredient, as I meant to try.——I conſtantly put down the lime upon the flat bottom of a common pewter plate, and with as much water as would ſufficiently wet it, worked it upon the plate, with a broad pointed knife, till it was become a tough but a pretty ſoft paſte. I afterwards added the quantity I intended of tarras, or other groſs matter, gradually; working it after each addition till it was become tough; and in this way, adding the groſs matter at three or four different times, I was generally enabled to get in the whole quantity, without any addition of water, more than had been neceſſary to bring the lime only at firſt to a proper conſiſtence. The whole was thus worked till it acquired a tough and ſtiff ductility; but if it happened, by the addition of too much water, to become too ſoft, I let it ſtand till it began to ſet, which might be quickened by putting it a few minutes upon a dry ſtone, or brick, and when it was a little hardened by partially ſetting, I worked it till it was brought to a ſtiff paſte; the whole of which operation took up generally above a quarter, and ſometimes near half an hour, to make a ſingle ball.

171. IN making up balls of mortar in this way, however well they were worked, if made up of no other ingredients but common lime and ſand; though this might be denominated excellent mortar for the common purpoſes of building, yet upon being immerſed in water, I found none of them which would not diſſolve; and therefore I judged ſuch ſort of mortar, however hard it might become by being gradually dried, was totally unfit for our work.——Balls even of the common compoſition of *Tarras* mortar (two parts ſlaked lime to one of tarras) I found would not always ſtand this teſt: but balls made up with *equal* meaſures of lime and tarras would in general ſtand it. This degree of information, though in itſelf very material, was ſoon attained; but as many points ſeemed to want inveſtigation, I regularly proceeded to determine the following queſtions.

Queſtion 1ſt. What difference in the effect reſults from lime burnt from ſtones of different qualities, in point of hardneſs?

* Theſe were my concluſions then; about which time the learned Dr. BLACK diſcovered that lime-ſtone by burning would loſe nearly ⅓ths of its weight, by the expulſion of *fixed Air*, which is driven off by the force of fire. And ſince him, Dr. HIGGINS has diſcovered, that a leſs quantity of the *Gas* is driven off by a leſs force of fire, *however long it is continued*; and that when compleatly driven off, that is in the proportion above, or nearly ſo, the lime then falls the moſt freely in quenching, or *ſlaking*, and to the moſt impalpable powder: and he concludes from a ſeries of experiments, that lime ſo burnt makes the beſt and hardeſt compoſition of *mortar*: but how far theſe concluſions will apply to *mortar* for *water* building, which has not the advantage of induration by drying, (as thoſe ſpecimens had which were the ſubject of the Doctor's experiments) it is ſtill out of my power to determine.——*Higgins on Calcareous Cements*, §. 2 and 4.

Chalk

Chalk lime is generally conſidered by workmen as the weakeſt of all; and it is accounted for in general, by its being burnt from one of the ſofteſt of all limeſtones.——The marble rocks near Plymouth are of ſo hard a nature, that the ſtone obtained from them to be burnt to lime (and which is the common lime of that country) is, by far the greater part of it, blaſted off with gunpowder. From obſervations of the buildings about Plymouth that had been conſtructed with this lime, at different periods of time, it appeared to me to be very nearly of the ſame nature with chalk lime; not only being of the brighteſt white, but of the ſame weak crumbly nature. I therefore made a couple of balls of tarras mortar of each ſort of lime in the above ſtated proportions of two to one; and alſo equal parts; and the reſult of ſeveral trials of the ſame kind was, that there was no apparent difference in the ſtrength thereof for the purpoſe of water building*.——Hence it appeared, as the effect of two limes was the ſame, from one of the ſtrongeſt and one of the weakeſt ſpecies of limeſtone; that the ſtrength of the lime muſt depend upon ſome other quality, than that of the *hardneſs* of the ſtone. So far, my experiments had proceeded with freſh *Water*.

Q. 2d. What difference reſults in the ſtrength of the mortar when made up with *freſh*, or with *Sea Water*; the compoſitions being immerſed in the ſame water?

Balls were made up in the former different proportions; one pair with ſalt and the other pair with freſh water, and this was ſeveral times repeated; the reſult was, that as to what happened immediately, or within the compaſs of a few days, there was no apparent difference; but of the balls which remained entire, when kept under water for two, or three months, thoſe made up with ſalt water appeared, if there was any difference, to have the preference. Hence I concluded, there was no need to burthen ourſelves, with carrying out *freſh* water to the Edyſtone for making the mortar: and in conſequence all future trials, except it is otherwiſe mentioned, were made with ſalt water †.

Q. 3d. What difference reſults from different *Qualities* of limeſtone, ſo far as I could procure the ſpecimens?

Having heard of a lime produced from a ſtone found at *Aberthaw*, upon the coaſt of *Glamorganſhire*, that had the ſame qualities of ſetting in water as *Tarras*, I was very anxious to procure ſome of the ſtone; which I did, and burnt it into lime. I found it to require a good deal of fire to make it, by quenching, fall into a fine powder. This ſtone, before burning, was of a very even, but dead ſky blue, with very few ſhining particles; but when burnt and ſifted, it was of a bright *buff colour*. Having made up a couple of balls, according to each of the former proportions; and alſo a couple of balls with common lime (by which I mean Plymouth lime) the difference of hardneſs after twenty-four hours was very remarkable: the compoſition of two meaſures of *Aberthaw* to one of *Tarras*, conſiderably exceeded in hardneſs that of common lime and *Tarras*, in equal parts: the compoſition of Aberthaw and Tarras in equal parts was ſtill conſiderably harder, and this difference was the more apparent, the longer the compoſitions were kept.

172. THUS encouraged, I was willing to try farther; and particularly to examine the validity of the notion entertained by workmen, reſpecting *Tarras Mortar*, that the longer it was kept and the oftener it was beaten over, the ſtronger it would ſet: for, as it would be likely to prove a very great incumbrance, in our ſituation, to keep our mortar in a ſtate of beating for a length of time, and from one time of uſing to another, it was very material to be thoroughly known, how far this was really the caſe; and if ſo, whether, for ſaving of time (to us *moſt* valuable) a greater proportion of tarras might not anſwer the ſame end as a longer beating: for it was evident, we ſhould have every *moveable* thing to carry to and from the rock each tide, along with ourſelves.

Q. 4th. Whether *Tarras Mortar*, after having been once well beaten, becomes better by being repeatedly beaten over again?

* This, though very contrary to the common opinion of workmen, is ſupported by the experiments of Dr. HIGGINS, which ſhew, that *Chalk Lime* well burnt was fully equal to the beſt ſort of *Stone Lime* he uſed; which he eſteemed that made from *Plymouth* marble, for the purpoſe to which his enquiries were directed; viz. Buildings in the *Air*. *Higgins* on *Calcareous Cements*. Sect. 24.

† In a compoſition of mortar for *Water-building* that BELIDOR gives from M. MILET DE MONVILLE, he uſes *Sea Water* for making the mortar of ſuch works as are expoſed to the *Sea*. Belidor, Arch. Hydraul. part 2. tom 2. p. 186.

To prove this, I made up a couple of balls of *Aberthaw* lime, one in each proportion above mentioned, and laid them in a damp place upon a water ſoaken brick, ſprinkled them with water, and covered them with a wet cloth; ſo that they might be as ſlow as poſſible in ſetting: theſe I broke down, and beat over again, every morning and night for three days: and then prepared a couple of balls of the ſame materials afreſh, and beat them very well. Theſe balls were, when ſet, put all together in ſalt water. Between theſe, where the compoſition was equal parts, there was *no diſcernible* difference: but of thoſe in which the lime predominated, the preference ſeemed due to ſuch as had had the repeated beatings; though the difference was not very remarkable.——The ſame experiments being tried with common lime, the preference was evidently more in favour of repeated beatings, in that compoſition in which the lime predominated (that is, the common one) than in that of equal quantities. Hence though the practice of workmen is very right, where common lime, and the ſmaller quantity of tarras, as in the common caſe, are uſed; yet where the tarras is not ſpared, and the lime is of ſuperior quality; the repetition of beatings appears not to be material: and therefore for *our uſe*, where nothing was to be ſpared, that could ſave time and labour upon the rock, the compoſition of equal quantities of Aberthaw lime and tarras ſeemed adapted in the beſt manner poſſible to the purpoſe.

173. I HAD heard that *Shell Lime*, that is, *Cockle* or other ſhells burnt, ſet very hard and made an excellent mortar for under-drawing, and inſide work. It is mentioned in WREN's *Parentalia* as having been made uſe of in *St. Paul*'s Cathedral for this purpoſe, and found excellent. On trying ſome of this mortar I found it to ſet hard, and readily, without any admixture of ſand, tarras, or other matter. In ſhort, for water work, tarras ſcarcely appeared to improve its natural quality. On being put into water, after it was ſet, it did not diſſolve, but did not acquire an additional hardneſs; on the contrary by degrees it macerated and diſſolved, not internally, but gradually from the ſurface inwards; and hence I concluded it totally unfit for our uſe. I was afterwards informed, that a part of the work at *Ramſgate Pier* had been done with this kind of lime, but was afterwards obliged to be taken up, on its diſſolving quality in ſea water being diſcovered.

174. HAVING obſerved how very ſpeedily *Plaſter* of *Paris*, from a ſemi-fluid ſtate would ſet into a hard ſubſtance, I conceived it might probably be of ſome uſe in our work. On making up a ball as I did with the mortars, but without beating, it very readily ſet; and did not diſſolve on putting it into water; but I ſoon found that, while in a moiſt ſtate, it had little firmneſs, and did not acquire any additional hardneſs under water; and by continuance, it became leſs firm: though I do not remember in the time I had it in trial (perhaps two or three months) that it re-diſſolved, either throughout its ſubſtance, or by maceration of its ſurface, like the ſhell lime*. I tried many experiments to improve its qualities by admixture, but did not find that either ſand or tarras was of any uſe: I alſo tried to beat it while in a pulp, which would for a little time prevent its ſetting, but this did not appear to produce any good effect, either alone, or with admixtures. Indeed I did not find that any thing was likely to give it ſolidity beyond what it naturally has; unleſs that after it was dry, it would then drink up linſeed oil plentifully; and which, if dried in its pores, would doubtleſs give it a conſiderable degree of ſolidity: but this treatment not being applicable to my purpoſes, I did not purſue the experiment any further.——However, the great readineſs wherewith I obſerved plaſter to ſet to a *moderate* degree of firmneſs, ſuggeſted to me this thought, which afterwards proved to be uſeful; that when there was not time for our cement to ſet, before it was ſubjected to the violence of the ſea, if it was coated over with plaſter, it might thereby be defended till it had time to ſet; and then, if the plaſter ſhould be waſhed off, it would be of no conſequence.

175. THE laſt ſpecies of lime I had an opportunity of trying in theſe my original experiments, was a kind that was much commended for water-works, and which is produced in the county of *Devon*,

* I am lately told, that Plaſter of Paris is liable to be perfectly diſſolved in a large quantity of water, if ſuffered to remain in it for a length of time, and eſpecially if the water is frequently changed or much agitated.

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at a place called *Bridiſtow*, about thirty-five miles north from Plymouth.——I procured a piece of this ſtone and burnt it: its appearance, both before and after burning, was much like that of Aberthaw, and on a ſimilar trial it anſwered pretty much in the ſame manner; but the compoſition formed with it appeared to be ſomewhat inferior in hardneſs: however, it ſeemed capable of becoming a ſubſtitute, in caſe I met with any difficulty in procuring that of *Aberthaw*.

176. HAVING now found a ſpecies of materials, and a method of compounding them, very competent to our purpoſe; and having plainly ſeen, that there was a great difference in the effect, ariſing from the different *nature* of lime burnt from different kinds of limeſtone; and that its acquiſition of hardneſs under water did not depend upon the hardneſs of the ſtone; inaſmuch as *Chalk* lime appeared to be as good, as that burnt from *Plymouth* marble; and that Aberthaw lime was greatly ſuperior to either, for the purpoſe of aquatic buildings, though ſcarcely ſo hard as Plymouth marble; I was very deſirous to get ſome light into ſome of the *ſenſible* qualities, that might probably occaſion the difference, or at leaſt become a *mark* of diſtinction. I therefore applied to my friend Mr. COOKWORTHY, whom I had found at all times ready to afford me his aſſiſtance, wherever his knowledge could be of uſe to me. He taught me how to *analyze* limeſtones: and though my *chemical* friends will be at no loſs upon this ſubject; yet as it is very poſſible, that ſome of my readers may be no more acquainted with chemiſtry than myſelf; for the ſake of theſe I will deſcribe the proceſs, as being uſeful for all thoſe who are concerned in building to know.

177. I TOOK about the quantity of five penny weights (or a *guinea*'s weight) of the limeſtone to be tried, bruiſed to a coarſe powder; upon which I poured common *aqua fortis*, but not ſo much at a time as to occaſion the effervescence to overtop the glaſs veſſel in which the limeſtone was put; and added freſh aqua fortis after the effervescence of the former quantity had ceaſed, till no further ebullition appeared, by any addition of the *acid*. This done, and the whole being left to ſettle, the liquor will generally acquire a tinge of ſome tranſparent colour; and if from the ſolution little or no ſediment drops, it may be accounted a *pure* limeſtone (which is generally the caſe with white *Chalk* and ſeveral others) as containing no uncalcareous matter: but if from the ſolution a quantity of matter is depoſited in the form of mud, this indicates a quantity of uncalcareous matter in its compoſition. When this is well ſettled, pour off the water, and repeatedly add water in the ſame way, ſtirring it and letting it ſettle till it becomes taſteleſs. After this let the mud be well ſtirred into the water, and without giving it time to ſettle, pour off the muddy water into another veſſel: and if there is any ſand or gritty matter left behind (as will frequently be the caſe) this collected by itſelf will aſcertain the quantity and ſpecies of fabulous matter that entered into the texture of the limeſtone. Letting now the muddy liquor ſettle, and pouring off the water, till no more can be got without an admixture of mud, leave the reſt to dry; which, when it comes to the conſiſtence of clay, or paſte, make it into a ball and dry it for farther examination.

178. ON treating common white chalk in this manner, the whole diſſolved into a tranſparent ſolution; and Plymouth marble, when free from apparent extraneous mixtures, did the ſame: but, as I found *Plaſter* would not effervesce with the acid, I therefore concluded that it was a peculiar ſubſtance diſtinct from limeſtone, having nothing calcareous in its compoſition*; and therefore that its cementing property depended upon ſome different principle.——On trying *Aberthaw* lime in this way, it was diſſolved in the aqua fortis; but the ſolution appeared very dark and muddy, and on examination I found a ſmall quantity of undiſſolved ſandy particles at the bottom, *ſome* of them tranſparent like cryſtals, but moſtly very minute, and of a dirty appearance. The muddy *reſiduum* being brought into an argillaceous ſtate, was very tough and tenacious while ſoft; and when ſufficiently hardened, being worked into a little ball, and dried, in that ſtate it appeared to be a very fine compact dark blue clay, and weighed nearly one-eighth part of the original maſs. One of theſe balls having been burnt became a good compact *brick*,

* Plaſter or *Gypſum*, as I have ſince been informed, is an earthy ſalt compoſed of calcareous matter diſſolved in the acid of *Vitriol*.

which

which being of a reddiſh colour, it from thence appeared, as I was told was the caſe, that it had an admixture of iron in its compoſition. On weighing it, I found that it had loſt near upon one-fourth part of its former weight in burning. *Bridiſtow* limeſtone, by the ſame mode of examination, exhibited nearly the ſame appearances.

179. FROM the experiments now related, I was convinced that the moſt *pure* limeſtone was not the beſt for making mortar, *eſpecially* for building in water: and this brought to my mind a maxim I had learnt from workmen; that the beſt lime for the *Land* was ſeldom the beſt for *Building* purpoſes; of which the reaſon now appeared; which was, that the moſt pure lime affording the greateſt quantity of *Lime Salts*, or impregnation, would beſt anſwer the purpoſes of *Agriculture:* whereas, for ſome reaſon or other, when a limeſtone is intimately mixed with a proportion of *Clay*, which by burning is converted into *Brick*, it is made to act more ſtrongly as a Cement*.——This ſuggeſted to me the idea, that an admixture of *Clay* in the compoſition of limeſtone, when treated as above ſpecified, might be the moſt certain index of the validity of a limeſtone for *Aquatic Buildings:* nor has any experience ſince contradicted it; as all the limeſtones in repute for water-works, that I have met with, have afforded this mark; even the *Darking* lime much eſteemed for theſe uſes at *London*, and in the country round about, is plainly nothing but a ſpecies of chalk, impregnated with clay, of which it makes one full ſeventeenth part of the original weight.

180. HAVING thus ſatisfied myſelf in reſpect to limeſtone, that, if I had not arrived at the beſt in the world, I had found one ſo competently good, as to anſwer every idea of what I could poſſibly want for the purpoſe of mortar for the Edyſtone Lighthouſe: I conſidered that though *Tarras* was really endowed with thoſe qualities, which had juſtly obtained it a reputation for water building; yet it was generally admitted to have ſome properties, that for our uſe were not quite ſo eligible.——In the firſt place, though it will cauſe moſt kinds of lime to ſet and become hard *under* water, as we have ſeen by ſeveral examples; yet if the Cement grows dry by a gradual expoſure to the air, it never ſets into a ſubſtance ſo hard as if the ſame lime had been mixed with good clean common ſand; but is very friable, and crumbly: and if, after it has acquired a conſiderable degree of hardneſs by immerſion in water, it is then expoſed to the air, it *loſes* a conſiderable part of its firmneſs, and alſo becomes crumbly: though according to my obſervation, it never becomes ſo much ſo, as if it never had acquired a greater hardneſs by a ſubmerſion in water.——For this reaſon, though there is no neceſſity for uſing it where the work will *always* be dry, or ſubjected only to the rain; and though it may be conſidered as being always wet, where it is in the joints of a maſſive work immerſed every tide; yet in our caſe, thoſe parts which were above the ordinary ſwell of the tide and ſea, and liable to be wet only in ſtorms, and hard gales of wind; and which, properly ſpeaking, could never wholly be immerſed, ſo that the pores might be thoroughly ſoaken with water; in ſuch a ſtate, between wet and dry, or of being wet and dry by intervals, tarras is known not to anſwer well. The knowledge, that in parts ſo circumſtanced, the mortar is the moſt liable to fail, and to be affected by the froſts, whatever its compoſition may be, has put artificers upon trying other mixtures; one of the principal of which was communicated to me by *Lord* MACCLESFIELD in his letter as under †.

181. ANOTHER

* It is not to be wondered at, that workmen generally prefer the more *pure* limes for building in the *Air*, becauſe being unmixed with any uncalcareous matter, they fall into the fineſt powder, and make the fineſt paſte, which will of courſe receive the greateſt quantity of *Sand* (generally the cheaper material) into its compoſition, without loſing its toughneſs beyond a certain degree, and requires the leaſt *labour* to bring it to the deſired conſiſtence: hence mortar made of ſuch lime, is the leaſt expenſive; and in *dry work* the difference of hardneſs, compared with others, is leſs apparent.

† "SIR, "London, 14th April, 1757.

"I was favoured with yours in due time, and ſhould have ſooner returned my thanks for it, had I not waited for a more "particular account of the manner of making the *Aſh Mortar*, than I could give you merely from my memory: and for which I "therefore ſent into the country, and received it only yeſterday. It may not, however, be improper to inform you, that the lime "that

181. ANOTHER property of tarras mortar is, that when kept always wet, and conſequently in a ſtate moſt favourable to its cementing principle, it throws out a ſubſtance ſomething like the ſtony concreſcences in caverns of limeſtone *Strata*, called *Stalactites*; which ſubſtance from the tarras comes to a conſiderable degree of hardneſs, and in time becomes ſo extuberant as to deform the face of the walls; and when ſmoothneſs and regularity of ſurface is wanted, as in navigable *Sluices*, mill *Conduits*, &c. it becomes neceſſary to remove its roughneſs by tools; for otherwiſe the tarras mortar will *grow* ſo much in the joints of theſe conduits, as to knock off the *Floats* or *Ladle-boards* from the wheels. I was therefore deſirous to try the properties of other ſubſtances, ſaid to be uſeful in making calcareous mortar to ſet in water; one of which I had found mentioned by BELIDOR*; and that is the *Terra Puzzolana* found in *Italy*.——In making enquiries how ſome of this might be procured from thence, I very fortunately learnt, that there was a quantity of it then in the hands of a merchant in *Plymouth*; which had been imported as an adventure from *Civita Vecchia* during the time *Weſtminſter Bridge* was building; and which he expected to have diſpoſed of for that work to a good advantage; but failed in his ſpeculation: for having found that tarras anſwered their purpoſe, neither *Commiſſioners*, *Engineers*, nor *Contractors*, would trouble themſelves to make a trial of it, and therefore refuſed it. This proved a lucky circumſtance to me; for it might otherwiſe have been many months before I could have got any for trial; and afterwards as many more, after finding it to anſwer, before I could have got a quantity from *Italy* for actual ſervice.

182. ON trial of this, I ſoon found it in every reſpect equal to *Tarras*, as far as concerned the hardening of water-mortar, if not preferable to it. And the merchant having had it long by him, and the keeping it being an inconvenience, he declared himſelf deſirous to get rid of it, conſiderably under the price of tarras; I therefore made no heſitation in purchaſing the whole quantity; and had the ſatisfaction to find, ſo far as time would give leave, antecedent to my actual uſe of it, not only that it appeared fully to anſwer every good end of tarras; but in letting it dry immediately, or keeping the balls ſometimes under water, and ſometimes in the open air, in which latter ſtate they were ſuffered to become perfectly dry; I perceived that in every ſtate of it, if made into a mortar with *Aberthaw* lime, it exceeded in hardneſs any of the compoſitions commonly uſed in dry work; and in *wet* and *dry*, or wholly wet, was far ſuperior to any I had ever ſeen or experienced; for, when the balls were immerſed in water, they appeared to acquire hardneſs *progreſſively*; which progreſs, while they were out of the water and became dry, was indeed ſuſpended, but yet they retained the hardneſs they had there acquired.——With reſpect to thoſe balls that were kept conſtantly under water, they did not ſeem inclined to undergo any change in form, only to acquire hardneſs gradually, inſomuch that I did not doubt but to make a cement that would equal the beſt *merchantable Portland Stone* in ſolidity and durability.

183. ALTHOUGH, in my main object, I had by degrees ſucceeded to my wiſhes; yet there was ſtill one circumſtance more that required inveſtigation.——My reader will perceive from the nature of the bond that I propoſed in my work (ſee Plate N° 13.) that one half of each piece of ſtone, being lodged in a dove-tail receſs, wherein it was locked faſt on three ſides, there was no way to get them into their places, but by letting them down perpendicularly: in conſequence of this, mortar beat up and prepared in a manner

" that is generally made uſe of in my neighbourhood is made from chalk, of which we have great plenty: though I am ſenſible that *Stone* " *Lime* is much ſtronger, and better; and that the ſtrength and goodneſs of the Aſh Mortar depends, in a great meaſure, upon its being " well beat, in which there is no danger of exceſs. The manner of making it (as ſent to me from the country) is as follows.

" Take of lime that is *very freſh*, two buſhels, and take of wood-aſhes three buſhels. Lay the aſhes in a round trench, and the lime " in the middle of the trench; then ſlake the lime, and mix it well with the aſhes. Let it lie thus till it is cold, and then beat it well to- " gether; and ſo beat it for three or four times before it is uſed.

" This mortar thus made is reckoned, by our bricklayers, to be much more ſtrong than that prepared with tarras, in places that are " at ſome times wet, and at others dry; though they acknowledge, that the tarras mortar is better in work that is conſtantly under water.

" It will give me much pleaſure if this communication ſhould be of any ſervice to you at any time, and eſpecially in carrying on the " work you have now in hand, which is of ſo great importance, and of ſuch public utility."

* Architecture Hydraulique, Part II. Tom II. p. 186. This indeed, is pointed out by VITRUVIUS in his Architecture, B. II. Ch. VI.

ſimilar to what has been ſpecified, could only be applied to the *ground* joint, or *under-bed* of each ſtone: the upright, or ſide joints (ſuppoſing the work to be cloſe put together) could not be lined with any quantity capable of filling the whole joint; for if that was attempted, the ſtone, in being *lowered* into its place, would carrry down the mortar, upon the ſides, along with it; leaving ſo little, as not to make thoſe joints ſolid and full. It therefore muſt become neceſſary, to conſolidate the upright joints, by pouring in *liquid* mortar, commonly called *Grout*, in ſo fluid a ſtate, as to run into every cavity and crevice.——The common way *then* in uſe of doing this was, by putting as much ſlaked lime into water, as when ſtirred would be ſufficiently fluid to anſwer the end; which is called *puttying*. And the *beſt* way then in practice was, to put the ingredients together according to the due proportion, to make the ſpecies of mortar intended, and with as much water as would render them fluid; and after *ſtirring* them well together, to pour the mixture into the joints.——Seeing therefore of how much importance it was to the ſolidity of our work, to attain the beſt method of *grouting*; and perceiving how great a degree of ſolidity was attained by the well *beating* of mortar, in compariſon of that which was only ſparingly *beaten*; it occurred to me to try the following experiment.

184. I TOOK about three times the quantities of materials, that were neceſſary to make a ball of the common ſize I uſed in my other experiments, and beat them well together, as I uſed to do for the beſt mortar; I then took the like quantities, and put them well mixed, but unbeaten, into a quart mug, with as much water, as that, when well ſtirred, the compound might be capable of being poured, like metal, into a mould. I then gradually added water to the beaten mortar, ſo as to reduce it by beating to ſo ſoft a pulp, as to require a veſſel to contain it, and put it into another quart pot, adding water by degrees, and ſtirring it well, till this, like the other, was alſo capable of being poured into a mould.—— Both the pots, with their contents, were then depoſited where they might be at reſt; and within an hour the groſs matter of both had ſeparated from the water by ſubſiding to the bottom, leaving the water clear at top.——The next day I perceived ſo entire a ſeparation of the materials from the water that it had become perfectly clear in both. On putting down my finger to the ſediment of the unbeat materials, I found it quite looſe and muddy, but making more reſiſtance underneath than at the top. The diſſolved mortar made a reſiſtance equal to that of ſoft clay at the top, and of ſtiff clay underneath: and afterwards examining them both from day to day, with a blunt-pointed ſtick, I found them to acquire a progreſſive firmneſs: for, in a week the unbeat ſtuff was become clayey, being ſoft at top, but of a ſtronger conſiſtence below; while at this time the diſſolved mortar was ſcarcely penetrable with the ſtick at top, and ſeemed to have acquired a ſtony hardneſs below. In the compaſs of a month both mixtures were grown ſo hard as not to be eaſily ſeparable from the veſſels: I therefore broke the pots, and found the contents of both had acquired a ſtony conſiſtence, each hardeſt at the bottom: that of the diſſolved mortar being conſiderably harder than the other, that is, of a moderate *ſtony-hardneſs*; not indeed equal to that of balls of the ſame age and compoſition, yet of a degree of hardneſs very ſatisfactory, and competent to my purpoſes. And as it appeared that thoſe compoſitions, notwithſtanding their being originally in a liquid ſtate, and always having had water upon them, yet acquired a ſtony hardneſs gradually; and that though they did it in a ſlower degree than undiſſolved mortar; yet in *length* of *time*, the grout made of the diſſolved mortar might become as compact as the undiſſolved mortar; I had therefore no doubt of being able to unite the whole of the materials of my building into one *ſolid maſs of ſtone*.

To avoid prolixity, I have mentioned theſe experiments as ſingle trials; but they were all repeated, and ſome of the principal ones ſeveral times. I alſo made trials of other compoſitions, which for the ſame reaſon I think it unneceſſary to mention; particularly ſeveral mixtures of lime with *Plaſter*; and though I am aware that the plaſterers uſe ſome compoſitions of this kind with advantage in their works, yet when ſubjected to the teſt for water-works, that I had eſtabliſhed for the conduct of my own experiments, I found nothing uſeful in all the mixtures of lime with plaſter, nor even of tarras and puzzolana with plaſter; as the reſult was, that they rendered the plaſter leſs ſpeedy in ſetting, and the plaſter rendered the compound, that would have reſulted from the other ingredients, leſs firm, and more crumbly.

185. THE

185. THE inquiſitive reader will undoubtedly be deſirous to know the nature of the two ſubſtances of ſo much conſequence in water building; viz. *Tarras* and *Puzzolana:* and I wiſh I was able to ſatisfy him in this reſpect, as well as I truſt I have been in the *application* of them to uſe. But if I tell him what has come to my knowledge and information, as this may incite the learned *Naturaliſt* and *Chemiſt* to enquire further, ſo as to give us more accurate accounts of their origin, natural compoſition, and properties, what I have to ſay on this head may have its uſe.

When I was in *Holland* in the year 1755, I made it my buſineſs to enquire, as particularly as I could, concerning the *Tarras*. I there ſaw the tarras ſtones, and was informed that they were brought down the rivers from *Germany*, (if I remember right, from the province of *Liege)* where this material is dug in mines under ground, and lies in regular *Strata*. I found it in lumps of various ſizes, from the bigneſs of a pea to that of a middle-ſized turnip. This ſtony ſubſtance is called in *Holland* the *Duif Steen*, ſignifying the *Dove Stone*, as I was told: it is of a light greyiſh colour, or aſh colour, is rather tender than hard, and is very *porous*, ſomewhat reſembling a pumice-ſtone. It is brought to Holland in the ſame ſtate as it is taken out of the earth, and the only art that is there employed in preparing it for uſe is, to reduce it to a coarſe powder, by means of mills for that purpoſe, which I ſaw. It is beat by iron-headed *Stampers* upon an iron bed, till it paſſes through a ſieve of a certain fineneſs, equivalent to one of ours, having about eight wires in an inch; it is then ready for uſe, and is generally ſent from Holland in caſks.——There ſeems to be nothing calcareous in its compoſition, for aqua fortis dropped upon it only wets it like water: to me it much reſembles ſome *petrifactions* that I have ſeen; but my more learned friends ſeem to be of opinion that it is a *Lava**.

186. THE Puzzolana is alſo a *porous* ſubſtance, and, like the tarras, produces no effervеſcence with aqua fortis: it has much the appearance of being a *volcanic* production, is of a brown colour, and, as my friend Mr. COOKWORTHY told me, contains iron; it has the look of an iron ore rendered porous, or burnt to a cinder by fire. It is ſaid to be found in large quantities in the neighbourhood of Mount *Veſuvius* and in ſeveral other parts of *Italy*. That which was the ſubject of my experiments, as well as the beſt of what I have ſince cauſed to be imported, or have ſeen, was from *Civita Vecchia:* I have ſeen a kind of puzzolana ſaid to be brought from *Naples*, of a leſs ruddy and more grey colour, but on trial I did not find it to be near ſo ſtrong as the former; for, one half of the quantity from *Civita Vecchia* would cauſe a compoſition of calcareous mortar to ſet harder in water, than that from *Naples* would do. ——It is ſaid, that the ancient baths and water-works of the *Romans* were built with this kind of mortar; and their duration has, it ſeems, proved the validity of the compoſition: but I apprehend, unleſs they have the *Lyas* limeſtone in Italy†, it was reſerved to the *Edyſtone*, to have thoſe two materials firſt combined; and of conſequence, ſo far as has yet appeared, the perfect compoſition of water mortar was now firſt aſcertained to be a proper mixture of blue *lyas* lime and puzzolana.

187. SEEING that both tarras and puzzolana agreed in two of their obvious properties, poroſity, and reſiſtance to the action of aqua fortis, as well as the hardening of calcareous mortar under water; and alſo, as *volcanic* ſubſtances, in having paſſed the fire‡, I was induced to try experiments on ſeveral porous ſubſtances, that appeared to have ſome ſimilarity to them; ſuch as *Pumice Stone*, *Coal Cinders*, *Brick* and *Tile Duſt*, and ſuch like. I found them all poſſeſſed of an abſorbent property, which cauſed the mortar made with them to ſet ſomewhat more quickly, than when made up with ſand only: ſo that where hardneſs is expected from *drying*, and time is wanted to produce the effect fully, they may be uſe-

* I now underſtand that this ſubſtance, when prepared for uſe, is by the *Dutch* called *Tras*, from which our appellation of *Tarras* undoubtedly originates. It is by ſome ſaid to be brought from *Andernach*. It is ſuppoſed to be the ſame as the *Peparino* of the *Italians*; which, as I underſtand, according to BERGMAN, is a concretion of *Volcanic* Cinders.

† *Lyas* is the general term for *ſtrata* of ſtone of the ſpecies of *Aberthaw*, in ſeveral counties.

‡ If *Tarras* and *Puzzolana* are much of the ſame nature, it would be curious to know why one ſubſtance cauſes the mortar to alter its form, or, as the workmen call it, *grow* in the joints under water; and the other to lie quiet.

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ful to this end, in procuring it to be done more *ſpeedily*; but being, when ſet, immerſed in water, they did not appear to poſſeſs any powers of reſiſtance to their diſſolution, more than the ſame lime would do with common ſand, if, by a little *more* time, the compoſition was become equally ſet.

188. HAVING made up my mind, that the proper compoſition for our mortar was, lime of *blue Lyas*, and *Puzzolana*, in equal quantities; and having procured a ſufficient quantity of puzzolana; it was now time to think of ſecuring to ourſelves, a ſufficient ſupply either of *lyas* lime, or lime*ſtone*.——In making enquiries on this head, I learnt that, for doing ſuch water building as they wanted at the city of *Exeter*, they procured the *blue lyas* lime ready burnt, from *Watchet*, a ſmall ſea-port of *Somerſetſhire*, lying upon the *Briſtol Channel*, almoſt right acroſs the *Peninſula*; but which, though near forty miles north from *Exeter*, they were obliged to carry on horſes backs: for if they waited to have it brought by ſea, round the *Land's End*, it would, in the length of time thus neceſſarily expended, attract ſo much moiſture from the air, that it would be reduced again to the ſtate of *Limeſtone*; after which, it would not fall into powder by *quenching:* and even if it got wet in the land carriage by the fall of rain, this would happen in ſuch a degree, that they were obliged to quench it with boiling water; and if that would not do, it was concluded to be ſpoilt.——Upon this information, it appeared to me, that the beſt way of procuring it in a ſufficient quantity for our uſe would be *in* the ſtone, and to burn it in our works at *Mill Bay:* but as the right management, and a thorough knowledge, of this article appeared of the utmoſt conſequence; that I might get all poſſible information concerning it, I determined to take a journey for that purpoſe to the country where it was produced, and in common uſe.

189. I SET out therefore on the ſixth of April, and firſt went to *Minehead*, another ſmall port upon the Briſtol Channel, a few miles farther weſt than *Watchet*; having been informed, that the *Pier* of Minehead had been built partly with lime from *Watchet*, and partly with that of *Aberthaw*; which lies alſo upon the Briſtol Channel, nearly oppoſite to it, upon the *Welch* coaſt.——On examining the works of this pier, it appeared to me, that thoſe done with *Watchet* lime were quite as good, or even preferable to thoſe done with that from *Aberthaw*; the parts ſo done being pointed out to me by a workman upon the ſpot, that had been employed in the erection: but as all agreed that they were the very ſame *Strata* of lyas-ſtone, that were found on each ſide the *Channel*, though at the diſtance of twenty miles; what difference there was, might very eaſily ariſe from a difference of treatment in making the mortar, or a more favourable ſeaſon of the year when the work was executed.

In paſſing through *Dunſter*, from Minehead to Watchet, as all the buildings in that part of the country were erected with lyas lime, I took care to remark the appearance of every kind, both wet and dry. And though the workmanſhip in general appeared but coarſely performed, yet the mortar bore to me the evident marks of being excellent; for, wherever I ſaw it, however coarſely it was done, yet it appeared full and fluſh in the joints, without cracks, or loſing its original ſkin, or becoming crumbly; as often is the caſe with mortar of a tender kind, after having gone through two or three winters, or more: and in one place I remarked the foundation of a little bridge, that by ſome accident had been driven down; but the mortar, over which the current was making its way, I found, on trying it with my knife, to have acquired ſuch a ſtony hardneſs, as, with a coat of moſs, effectually defended it from the action of the water; yet it was conſiderably inferior, in hardneſs and firmneſs, to the balls I had made with lyas lime mixt either with *Tarras*, or *Puzzolana*.

190. ON my arrival at *Watchet*, I firſt examined the pier there, which, though but a rough piece of work, I found to be quite ſatisfactory, as to the mortar part; and learnt, that they made no ſcruple of mixing it up with *Sea* water.——On viewing the ſituation, in which the *Lyas Stone* lies here in its natural bed, I found, that the ſea retreated from the ſhore to a conſiderable breadth, or diſtance, at low water; and in this inclining ſurface very many *Strata* of lyas ſtone, of different thickneſſes, appear, chiefly from four or five to ten or eleven inches thick, but all apparently of the ſame quality; being indiſcriminately

nately taken by the lime-burners according as they find them moſt convenient to be come at.——Theſe *Strata* are not much inclined to the horizon, but more ſo than the general inclination of the ſhore; and therefore, as they dip towards the low water mark, a vaſt number are expoſed to view. The *Lyas* ſeems univerſally to lie in a bed of uncalcareous laminated blue matter, and which, when expoſed to the weather, ſeems to turn to much of the ſame kind of looking clay, that I found by my experiments to be intimately mixed with the calcareous *Strata*.——The bed, or *Matrix* in which the Lyas lies, being of a ſoftiſh periſhable nature, it is found eaſy to detach the ſtone with an iron *Crow*; and therefore though there is plenty of the ſame kind of ſtone to be found in *Strata* within land; yet as there is no great demand for this kind of lime, the lime-burners can procure what they want in ſufficient quantity from the ſhelving ſea-ſhore juſt deſcribed, with more eaſe than by laying open the ground.

It perhaps will ſeem wonderful, that for a lime ſo excellent in quality there ſhould be no great demand; for in reality I found but one ſmall lime-kiln; and that not kept conſtantly at work: but conſidering the occaſions of the neighbouring country for building-lime not to be great; and the charge, trouble, and difficulty attending the carrying it to a diſtance to be conſiderable; and that it does not ſuit the purpoſes of *Agriculture*, even upon the very ſpot where it is produced, the wonder will undoubtedly ceaſe: and I was informed by the lime-burners themſelves, that for the uſe of their own farm, they were obliged to get lime from the rocks of *St. Vincent* near the *Hot Wells* of *Briſtol*; or of that quality, at the diſtance of more than 40 miles: for, they told me, were they to lay their own lime (though reduced to a fine powder) upon the land, the firſt ſhower of rain would turn it all to ſtone, without affording any ſenſible cultivation to the land: and as the rocks of *St. Vincent*, are ſomewhat like the *Plymouth* marble; this circumſtance affords another proof, that the qualities of lime, for different uſes, do not depend upon the *hardneſs*, but upon the *ſpecific* qualities of the ſtone from whence it is burnt.

A queſtion now aroſe, how I was to get ſupplied with lime in the quantity I wanted; as I found that the lime-burners were under a prohibition from the lord of the manor, to ſend away unburnt ſtone: and alſo that the difficulties of getting it on horſeback acroſs the country to *Exeter*, &c. were not exaggerated: but I was informed, that this lime, if burnt to a due degree, and quenched hot from the kiln, would fall to a powder as freely as any other kind of lime; and that to prevent its imbibing moiſture from the air, they always mixed it up for uſe, as ſoon, or as *hot* (as they term it) as poſſible, and having ſo done, find it to ſet the ſtronger, when uſed for works under water. They alſo informed me, that, if kept *cloſe* from the *Air*, it would preſerve its virtue for a conſiderable length of time. Conſequently nothing in this mode was to be depended on, but *Water tight* caſks; the procuring of which without great expence and loſs of time, appeared a conſiderable difficulty; as it was at firſt apprehended they muſt be brought from *Briſtol*.——On enquiry however I found that much cyder was produced in this part of the country; and fortunately it was a time of the year, when many of the caſks for this liquor were empty.——What quantity of *caſking* would hold a given quantity of burnt lime was a matter untried; as this mode of ſending it away was not in uſe with them.——I wiſhed much to ſee the proceſs of burning it, and quenching it when burnt; and therefore by way of inveſtigating what quantity of caſking would be wanted, I ordered a kiln of lime to be put on, and having procured ſome *Cyder* caſks, and the lime to be quenched and ſifted, immediately from the kiln; it ſlaked as I had been told, very freely, affording a very ſoft impalpable powder. We proceeded upon the package as follows.——I cauſed a quantity of their burnt lime, which they delivered for a *Hogſhead* and half, to be weighed from the kiln, which was 4½ cwt. This being quenched, and ſifted, the dry meal was the ſame weight as before: ſo that the water it had imbibed in quenching compenſated for the waſte in ſifting: and in this ſtate the produce from the hogſhead and half, of *lime meaſure*, could be rammed into a cyder hogſhead caſk; ſo that in reality it was of leſs bulk and weight than it would have been if ſent away *unſlaked*, and of conſiderably leſs weight than it would have been if ſent in the unburnt ſtone; which, in common with other limeſtones, is found to loſe a conſiderable part of its weight in burning. The quantity therefore of 20 tons, which I propoſed to procure, would be packed in 90 ſuch hogſheads. I therefore employed a reputable merchant there to procure the caſks, hire a veſſel, and forward the lime; and 135 hogſheads of

burnt lime, rammed into 80 caſks, containing in the whole 110 hogſheads wine meaſure, arrived at *Mill Bay* ſoon after my return*.

191. THE *blue Lyas* ſtone of *Watchet* is of a dead ſky blue†, of a very fine even froſted grain when broken, with few ſhining particles. There is alſo in ſeveral parts of that county another kind of limeſtone, which they call the *white Lyas*; which has the ſame kind of grain, with a ſmall quantity of ſhining particles, and has much the ſame appearance, the colour only excepted, as the blue; it alſo lies in *Strata* of nearly the ſame thickneſs; and though of a chalky whiteneſs, is quite as hard, or rather harder than the blue: yet it is held in no eſtimation for *Water Works*; and at which indeed when I had *analyzed* it, I did not wonder, as I found it almoſt wholly to diſſolve, and become ſuſpended in aqua fortis. The *Reſiduum*, which was very ſmall in quantity, was of a light reddiſh colour, and contained a few particles of tranſparent cryſtals.——In paſſing the cliffs upon the ſea coaſt between Mine-head and Watchet, I found frequent veins of *Gypſum* or plaſter, interſperſed with *Strata* of limeſtone, of a kind having impreſſions of foſſil ſhells included in it; but obſerved no appearance of marks of foſſil ſhells in either the *blue Lyas* of Watchet, or the *white Lyas* of *Somerſetſhire*.

192. BEING now determined as to the compoſition of the mortar for the Edyſtone; I might here very properly put a period to this part of my ſubject: but my reader, after giving him the preceding account of its great utility, will not perhaps be diſpleaſed, if I communicate to him the principal obſervations that have occurred to me in a courſe of thirty years practice in water building.

As nothing could ſucceed better, or be more ſatisfactory, than the mortar I uſed, as will be further ſeen in the courſe of my proceedings; I wiſhed to examine all thoſe limes which diſcovered any degree of fitneſs for *Water Building*; and more eſpecially, if poſſible, to find out a ſubſtitute for *Tarras* and *Puzzolana* in this kingdom; that we might be in poſſeſſion of *all* the beſt materials for water building within ourſelves: and though I own I have not ſucceeded with reſpect to the latter, ſo far as my ardent wiſhes led me to hope; yet as I have ſince learnt how to compoſe water cement with a far leſs proportion of the foreign materials than I at firſt uſed, and upon the whole at a much leſs expence, I truſt this inveſtigation will be thought material and uſeful.

The Limes that I have ſince examined are as follows:

193. 1ſt. THAT of *Barrow* in *Leiceſterſhire*, of which we uſed conſiderable quantities in the *Calder Navigation*. I never was at the quarries, but having procured ſome of the unburnt ſtone, I found it had the appearance of blue Lyas, only ſomewhat of a more yellow tinge, and more of the ſlate kind: it burns to a buff coloured lime like that of Aberthaw and Watchet, and on diſſolution affords nearly $\frac{1}{4}$ths of its original weight, of blue clay, with a minute quantity of dirty grey ſand; ſo that I have no doubt of its being the true *Lyas*, though perhaps of a leſs perfect compoſition than that bordering on the *Briſtol Channel*. It contains more clay, can be carried further, and remains longer without injury‡; but in the actual uſe thereof as mortar, it does not appear to me to acquire quite ſo firm and ſtony a hardneſs, as the blue Lyas of *Somerſetſhire*. It makes however excellent water mortar, if properly treated, and will very well ſerve in thoſe parts of the kingdom that are more acceſſible to the *Trent* navigation, than that of the *Briſtol Channel*. ——In fact, in travelling from *Glamorganſhire* through *Monmouthſhire*, *Glouceſterſhire*, and *Warwick-*

* This mode of conveyance was in reality ſo ſucceſsful, that ſeveral caſks of this very lime which remained, after the Lighthouſe was finiſhed, were afterwards carried into *Yorkſhire*, and uſed in the moſt critical part of the works of the River *Calder*, and remained perfectly good from the year 1757 to the laſt uſed in 1764: only, that as it had become ſomewhat lumpy, the fine powder was ſifted out, and the reſt by gentle bruiſing was reduced to powder, ſo that the whole paſſed through a fine wire ſieve.

† This was the deſcription of it at the time, but on breaking a ſpecimen of it that I have now by me, I ſhould rather ſay, it is of a dark lead colour, ſomewhat inclining to brown. I therefore ſuſpect it has altered its colour by keeping.

‡ The practice in ſending it away is, in the *burnt ſtone*, packed *unquenched* in caſks that have held ſugar and grocer's dry goods; but where the demand is conſiderable, I have practiced myſelf the getting the unburnt ſtone, and calcining it upon the place.

ſhire,

ſhire, into *Leiceſterſhire*, I found ſuch frequent inſtances of ordinary walls and cottages, built with ſtone that appeared to me to be blue Lyas, the mortar alſo being of the ſame hue, that I have not a doubt, but that the curious naturaliſt, in making this expreſsly an object of ſearch, would be able to trace it from *Aberthaw* and *Watchet* quite to *Barrow*; though probably with ſeveral breaks, as is uſual in the arrangement of the *Strata* of the earth. At *Bath* they pave the ſtreets with a ſpecies of Lyas; and to render the pavement more durable by keeping out the wet, they joint the paving with mortar of the ſame kind of ſtone.——The Bath *Free Stone* is of the pure calcareous kind; and it is remarked, that when it is walled with this kind of mortar, which is *frequently*, if not generally, uſed for the purpoſe, the joints are more permanent, and reſiſt the weather even better, than the ſtone itſelf: and it is this circumſtance, which gives that peculiar firmneſs to be obſerved in the light and thin walls of the buildings of that city.—— From *Leiceſterſhire* it appears to paſs by the Vale of *Belvoir* into *Nottinghamſhire* and *Lincolnſhire*; for, a ſpecies of this kind of lime is uſed in ſome of the buildings about *Newark**; and the *Great North Road* is repaired with the blue Lyas ſtone for a conſiderable length in the poſt ſtage between *Newark* and *Grantham:* at *Long Bennington* (a village of *Lincolnſhire*, through which the road paſſes on that ſtage) there is a lime-kiln for burning it. I have not yet ſeen it farther north than this, nor any where north of the *Trent*. The limeſtone at Long Bennington contains $\frac{1}{17}$ blue clay.

194. 2d. PERHAPS nothing will better ſhew that the qualities of lime for water mortar do not depend on hardneſs or colour, than a compariſon of the white Lyas of *Somerſetſhire*, (which, though approaching to a flinty hardneſs, has yet a chalky appearance) with what is called near *Lewis* in *Suſſex*, the *Clunch Lime*; a kind of lime in great repute there for water works, and indeed deſervedly ſo. This is no other than a ſpecies of chalk, not found, like the Lyas, in thin *Strata*, but in thick maſſes, as chalk generally is: it is conſiderably harder than common chalk, but yet of the loweſt degree of what may be denominated a ſtony hardneſs; it is heavier than common chalk, and not near ſo white, inclining toward a yellowiſh aſh colour.——This ſtone, when analyzed, is found to contain $\frac{1}{8}$th parts of its weight of yellowiſh clay, with a ſmall quantity of ſand, ſeemingly of the cryſtal kind, not quite tranſparent, but intermixed with red ſpots. Hence the fitneſs of lime for water building ſeems neither to depend upon the hardneſs of the ſtone, the thickneſs of the *ſtratum*, nor the bed or matrix in which it is found, nor merely on the *quantity* of clay it contains: but, in burning and falling down into a powder of a *buff* coloured tinge, and in containing a conſiderable quantity of clay, I have found all the water limes to agree. Of this kind I eſteem the lime from *Darking* in *Surrey* to be; which is brought to London under the idea of its being burnt from a *Stone*, and in conſequence of that, of its being *ſtronger* than the chalk lime in common uſe there; though in fact it is a *chalk*, and not much harder than common chalk: it contains $\frac{1}{17}$ part of light coloured clay of a *yellowiſh* tinge.

195. 3d. THERE is in *Lancaſhire* a lime famous for water building, called *Sutton* lime: I have lately had an opportunity, by favour of JOHN GILBERT, Eſq. to get a ſpecimen of the ſtone in its natural ſtate. I had long ſince ſeen it in the Duke of BRIDGEWATER's works both in the burnt ſtone and ſlaked, made up for uſe, and in the water. I obſerved that it agreed with the Lyas in being of a *buff Caſt*. The ſtone itſelf is of a deep brown colour, and the piece I have is from a ſtratum about three inches thick, with a white clayey coat on each ſide. The goodneſs of the quality, as water lime, does not therefore conſiſt in the colour before it is burnt; for we have already ſeen *blue*, *whitiſh*, and now *brown*, to be all good for that purpoſe; but they all agree in the colour or hue, *after* they are burnt and quenched: and having analyzed the Sutton limeſtone, I find it to contain not only near $\frac{1}{10}$th parts of the original weight of the ſtone of brown or red clay, but alſo $\frac{1}{11}$dth of fine brown ſand; ſo that in reality I have ſeen no lime yet, proved to be good for water building, but what, on examination of the ſtone, contained clay: and though I am very far from laying this down as an abſolute *Criterion*, yet I have never found any limeſtone containing clay in a conſiderable quantity, but what was good for water building; and limes of this kind

* The lime quarries from whence *Newark* is ſupplied with this kind of lime is from the village of *Cuddington*, about 2½ miles S. E. from Newark, and betwixt the North Road and the *Trent*.

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all agree in one more property, that of being of a dead frofted furface on breaking, without much appearance of fhining particles.

196. SINCE the above was written, I have had the opportunity of examining others of the *Water Limeſtones*. I find a ſpecies of lime has been uſed in ſome of the works about *Portſmouth*, and recommended as very good for water building, where the expence of *Tarras* mortar made with chalk lime could not be *afforded*. It is called *Grey Lime*, as having been burnt from a ſpecies of ſtone called *Grey Chalk*. This by inſpection I obſerved to agree ſo nearly with the *Clunch* lime I had formerly obſerved near *Lewis* (and then analyzed) that in a conſultation with His *Majeſty's Engineers* concerning certain works at *Portſmouth*, I ventured to recommend it to be uſed in thoſe works, in *preference of common Chalk Lime*, for forming a proper *Water-Cement*. This *Grey Lime* goes by land carriage from the pariſh of *Berryton* near *Peterſfield* in *Hampſhire* to *Portſmouth*. I viſited the place, and obſerved that the country thereabouts was of this kind of chalk; and they call it here *Grey* lime, by way of diſtinction from common chalk or *white* lime: yet in its colour, hardneſs, and appearance both before burning and after, it is ſo like the *Suſſex Clunch* before deſcribed, that I would not undertake by ſight to diſtinguiſh them. Its appearance was alſo ſimilar to that of the *Darking* lime before mentioned; and though the *Grey Lime* afforded, on diſſolution, a leſs quantity of clay than *Suſſex Clunch*, yet it yielded $\frac{1}{10}$th part of clay; which is a conſiderably greater proportion than the *Darking* lime affords; and yet I have proved this laſt in uſe to be a very competent *Water Lime*.

In my return from *Portſmouth* in April 1787, I recollected that about twenty-five years ago I was conſulted about putting on foot the extenſion of the navigation of the river *Wey* from Guildford to *Godalmin*; and being then ſhewn the different chalk pits in the neighbourhood of Guildford, I recommended it to the *reſident* ſurveyor to make uſe of one, in preference to the reſt I ſaw, for building the locks, &c. merely becauſe it had a *clayey look*; not imagining at that time (which was conſiderably antecedent to my acquaintance with the *Suſſex Clunch*) that any *very* good water lime could be produced by any kind of *Chalk*. This induced me now to viſit *Guildford Lock*; and in going thither, I found the *hawling* track for the navigation by horſes, made good and covered with this very chalk ſtone broken ſmall: and on examining the lock I found the mortar joints of the brick walling very compleat, eſpecially where they were frequently immerſed in water.——On bringing away a fragment with me for examination, I find it to contain $\frac{1}{10}$th parts of a dark coloured clay: the ſtone, however, is of a *yellowiſh* hue, much like all the chalks I have mentioned as containing clay.——Whether this lime has by theſe or any other means become known in the neighbourhood of *Guildford*, as peculiarly good for water works, I had not the means then of getting proper information: but whether ſo, or not, this may prove an uſeful hint to the London *Builders*, as theſe lime-ſtones may, by means of the water-carriage, be brought *raw* down to *London*, and burnt here; where coals are cheaper than at Guildford: and I am alſo led to think, that the curious naturaliſt will find ſome connection of this lime-ſtone to ſubſiſt through all this range of *Chalk Hills*, from Lewis to *Peterſfield*; and probably from thence into *Surrey*, to Guildford and *Darking*.

In travelling the weſt road from *Bridport* in *Dorſetſhire* to *Axminſter*, the country puts on much the appearance of the *Blue Lyas*; and from a ſhard I broke off from a wall at *Axminſter*, I have proved that it contains clay in conſiderable quantity; but was particularly happy in being informed from the ocular teſtimony of my highly reſpected friends the honourable Mr. CAVENDISH and Dr. BLAGDEN, the *blue Lyas* actually exiſts in quantity at *Lyme** in the ſame county; and is there burnt into lime for ſale: which place being a ſmall *Sea-port*, upon the ſtrength of this information, I not only recommended it in 1787 to be uſed in the *King's Works* at *Plymouth*, inſtead of lime from their own marble, where water is concerned, but propoſe alſo to uſe it for the ſame kind of works at *Ramſgate* harbour. And I have not the leaſt doubt, but that after it is known, *what to look for*, good water lime will be diſcovered in many

* *Lyme* being almoſt right acroſs the *Iſthmus*, and not above forty miles diſtant from *Watchet*, it is probable this *Stratum* is found at intermediate places.——Since the above was ſettled for the preſs I have been at LYME, and have had the opportunity of confirming the above from my own ocular inſpection. There is a ſmall limekiln upon the pier, (or *Cobb* as called;) but what goes away by water, is chiefly in the unburnt ſtone.

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diſtant parts of this kingdom, either of the *Lyas* or the *Chalk* ſpecies; which laſt, though ſeemingly very diſtinct, yet ſo nearly conduces to the ſame end, that (excluſive of my *original partiality)* I am almoſt at a loſs which to prefer.

The following *Table* contains, in one view, the account of nine different *Water* limeſtones that I have already particularly mentioned to have analyzed.

N°	Species of Limeſtone.	Proportion of Clay.	Colour of the Clay.	Reduction of Weight by burning.	Colour of the Brick.
1	Aberthaw - - -	$\frac{3}{23}$	Lead colour	4 to 3	Grey ſtock brick.
2	Watchet - - -	$\frac{3}{25}$	The ſame	4 — 3	Light colour, reddiſh hue.
3	Barrow - - - -	$\frac{3}{14}$	The ſame	3 — 2	Grey ſtock brick.
4	Long Bennington -	$\frac{3}{22}$	The ſame	—	Dirty blue.
5	Suſſex Clunch - -	$\frac{3}{16}$	Aſh colour	3 — 2	Aſh colour.
6	Darking - - -	$\frac{1}{17}$	The ſame		
7	Berryton Grey Lime -	$\frac{1}{12}$	The ſame		
8	Guildford - - -	$\frac{2}{19}$	The ſame		
9	Sutton - - - -	$\frac{3}{16}$	Brown		

197. UPON the ſubject of a *Succedaneum* for *Tarras* or *Puzzolana*, I have not ſeen any thing ſimilar in appearance to *Tarras*, but what has been of the *calcareous* kind; but as the puzzolana was found to contain ſome iron, and I had ſeen maſſes of gravel ſtrongly cemented (as it appeared to me) with nothing but pieces of malleable iron turned to ruſt, I had better expectations of ſucceſs from the iron tribe. I therefore tried the ſcales that fall from the iron at a ſmith's anvil, which have long been known to be an excellent ingredient in making calcareous cement, and particularly where expoſed to weather, or where water is concerned; and which being well powdered, and mixed with lime, in the ſame proportion, and treated in the ſame manner, as puzzolana, I found (ſo far as I could obſerve) to produce an *equal* effect.——A peck of ſmith's forge ſcales is eaſily collected occaſionally, to do a ſmall *Job*; but to procure four or five tons, would be far more expenſive than to bring ſo much puzzolana from *Italy*. With a view therefore to works requiring large quantities, I tried *Iron Ore*, after it had paſſed the fire, and undergone what is commonly called calcination.——This being powdered, I found had a very good effect in water mortar, in cauſing it to ſet ſpeedily, in preventing cracks, and finally, in hardening it. On this account it was uſed in the *Calder Navigation*, for the inſide mortar of the beſt work, and for the *face work* of the ſubordinate parts: but its ſtrength in hardening lime was far inferior to that of *Puzzolana* or of *Forge Scales*. What I uſed was the ſiftings of the iron ſtone, after calcination at the iron furnaces; which being deemed too ſmall and light to go into the furnace, was thereby the better adapted to my uſe. I found that at the iron works it had been frequently made uſe of, to mix with lime in making mortar for the conſtruction and repair of the water-building part of their *own* works; and the parts ſo ſifted not being too large for the joints of their maſonry, and having it in plenty at hand, they uſed it as it was; but after a land carriage of ſeveral miles, when brought to us, we ground it on a mill, to open its qualities and make it more effectual, as well as go further. This material, among the furnace men in theſe parts, is called *Minion**.

198. MINION, or iron ſtone burnt where it can be had in plenty, is a good *ſuccedaneum* for puzzolana and tarras; and if it is made up with lyas, or other proper water lime, in equal quantities, will make a mortar more firm and hard than common lime, made up with the common quantity of tarras or

* *Minion* is ſuppoſed by Mr. MICHELL to be what chiefly falls from the outſide of the lumps of the iron ſtone, and therefore containing more clay.

puzzolana *: and hence we may be ſaid to have materials within ourſelves, to ſerve the general purpoſes of water works; but not ſo perfectly and compleatly, as by the uſe of either of the foreign materials above ſpecified.

Wherever I have met with a reddiſh, or a browniſh ſtone, I have generally made trial of it, but never yet found any thing to anſwer ſo well as forge ſcales; except once, that I picked up a kind of coarſe deep brown ſand ſtone, ſomewhat of a tender nature; which having burnt, powdered, ſifted, and mixed with *ſlaked* lime, I made into a ball, and it proved of equal firmneſs with forge ſcales: but as it was a fragment found upon the ſurface of the earth, intermixed with others of different colour and kind, without the appearance of my being able to procure a quantity of it, I ſaw no probable uſe likely to reſult from this diſcovery, further than that of the reaſon for which I mention it; which is, that of demonſtrating the exiſtence in nature of the material we want, in this kingdom, if we could but tell where to find a quarry, or ſufficient ſtratum of it; in which, though I have not ſucceeded myſelf, yet others may find a quantity either of this, or ſomething equivalent to it †.

199. I COME now to ſhew the means I have uſed to make a given quantity of tarras, or puzzolana, produce a greater quantity of good *Water Mortar*, than either the common compoſition, where the dear material is ſparingly uſed; or that I uſed at the Edyſtone, where nothing was ſpared that had the appearance of being of ſervice.——And if upon this head, I ſhould ſomewhat enlarge, I flatter myſelf, I ſhall be forgiven by a majority of my readers.——Limeſtone, as it is now generally known, loſes about $\frac{1}{3}$ths its weight by burning, but ſhrinks an inconſiderable quantity in point of bulk ‡; but upon quenching it, when fully burnt, it falls freely, and will produce ſomewhat better than double the quantity of powder or *ſlaked lime*, in point of meaſure, that the burnt limeſtone conſiſted of; and this will be nearly the caſe, whether it is common lime or *water* lime. Suppoſing it common lime, if this is beat into a paſte with a ſufficient quantity of water, it will not in this ſtate occupy quite half the ſpace it did before in powder; but if to this paſte from two meaſures of lime, we add one meaſure of tarras, which makes the ordinary compoſition of *Tarras Mortar*, the quantity will be enlarged, ſo as to produce about $1\frac{1}{2}$ meaſure of mortar; and then the bulk will be ſomething greater than it was in either the burnt or unburnt ſtone §.

200. THE uſe of ſand in mortar, ſo far as I have been able to obſerve, is twofold; 1ſt. To render the compoſition harder; and 2dly, To increaſe it in quantity, by a material, that in moſt ſituations is of far leſs expence, bulk for bulk, than lime. As there is no apparent change in the ſand, by the admixture of the lime, the ſand ſeems only to render the compoſition harder, by itſelf being a harder body; for the beſt ſand, being ſmall fragments of flint, cryſtal, *quartz*, &c. is much harder than any body we

* The following compoſition I directed to be uſed in building the firſt *Lock* upon the *River Calder*, in the year 1760; and which I lately tranſcribed from the *Memorandum* Book of Mr. JOSEPH NICKALLS, *Civil Engineer*, at that time *reſident Surveyor* of the River Calder.

For *Face* Mortar, *Barrow* Lime — —	meaſures	4
Ground *Minion* — — —	—	2
Coarſe Sand — — — —	—	2
Fine Sand — — — —	—	2

And for the rubble backing; to the above compoſition, add eight meaſures of ſmall gravel, or pebbles, the largeſt not larger than a horſe-bean; which application of *Pebbles* was taken from what I obſerved at *Corf Caſtle*, §. 99.

† This ſtone was picked up in the high part of the country, in the beaten track of a moor, called *Wooley Edge*, not far weſt of the direct road between *Wakefield* and *Barnſley* in *Yorkſhire*; and where a number of ſtones of the ſame kind may be found; but yet it would be attended with ſome trouble to gather a cart load of it.

‡ My experiments were upon *Water* limeſtones; but according to the experiments of the *Biſhop* of LANDAFF, upon various kinds of common limeſtone, it did not appear with certainty to have ſhrunk at all. See WATSON's *Chemical Eſſays*, vol. ii. page 230.

§ Two meaſures of *Water Lime* in powder, will produce nearly one meaſure of paſte; and this, with one meaſure of tarras or puzzolana, will produce nearly $1\frac{4}{10}$ meaſure of mortar.

know

know of, that can be formed of lime only; and which, in paſte, is to be conſidered as a cement to the harder materials, and therefore compoſes a harder body; for the ſame reaſon that, if we had nothing naturally, but lime as a cement, and ſhould build a wall with flints, cryſtals, or rough ſtones cemented therewith, this wall would be far harder than if built with lime alone.

201. THE experience of ages has ſhewn, that a conſiderable quantity of ſand and other matter may be introduced with advantage in the making of mortar; but the proportion has never been agreed in: yet from common experience it appears, that there is ſcarcely any lime, but what, if well burnt and beaten, a load, or meaſure of lime, will take two loads or meaſures of ſand; that is, the quantity of ſand that can be introduced into its compoſition may be equal to the lime in powder: and conſequently if, as in tarras mortar, one meaſure of tarras is ſufficient to give to two meaſures of ſlaked lime a ſufficient *indurating* property, to make the compoſition acquire the propoſed degree of hardneſs under water; then if another meaſure of clean ſand is added, this will only give to the lime that quantity of the harder material that it would bear for building in the air; and this without hurting its cementing property in water; for as the ſand can hardly be ſuppoſed to act on either material, ſo as to alter their *chymical* action on one another; it will, at the ſame time that it increaſes the bulk of the whole to half as much more, be cemented together by the other ingredients, and make (for the ſame reaſons as in dry work) a *harder* compoſition.——Thus far we are warranted to proceed from the common practice; and as this increaſes the quantity, that would reſult from the common tarras compoſition, in proportion of 2 to 3, I was therefore willing to try this matter further. Thus,

A compoſition of this kind is further increaſed in bulk, by another meaſure of ſand; ſo that one cube foot or meaſure of the common tarras mortar compoſition will by this means become two, and quite as good in every reſpect.——Finding this idea ſo far to anſwer, not only in experiment, but my expectations ſatisfied in works at large, I was induced to try whether lime would not bear a ſtill greater addition of ſand; and I ſoon found that it would, with good beating, take in, for every two meaſures of ſlaked lime, one meaſure of tarras, and three of clean ſand; which would produce nearly 3½ meaſures of good water mortar, or full 2½ times the common quantity of mortar from the ſame quantity of tarras and lime; this being near upon four times the bulk in *ſolid mortar*, of the unquenched lime, or the unburnt ſtone.

202. STILL purſuing the ſame line of experiment, to ſee how far this matter could be carried, it appeared that even yet a greater proportion of ſand might be introduced; but to bring it to a proper conſiſtence and toughneſs, ſo as to be a good cement to large ſtones, I found it needed ſo much *more* beating, that the *labour* became, in moſt caſes, of more value than the ſaving of materials*.——Thus far I had proceeded

* This laſt proportion of lime to ſand (allowing for the tarras, which does not appear to me to make ſo great an increaſe of bulk as is made by common ſand) nearly agrees with the greateſt mixture of ſand with lime in the experiments of Dr. HIGGINS; ſee *Calcareous Cements*, page 48; wherein N° 5, contains a mixture of lime to ſand as 1 to 8; yet as this is expreſsly by *weight*, and as the weight of Thames ſand is nearly 4½ times the weight of ſuch common lime as I have tried, bulk for bulk, this will not amount to the full proportion of two meaſures of ſand to one of lime in powder: and though the *Doctor* ſays that this "Specimen was not ſufficiently plaſtic for common "uſe, or, as the workmen expreſs themſelves, it was *too ſhort*;" yet as his experiments ſeem, in a great meaſure, to turn upon the method of compounding calcareous cements for *dry work*; where they are continually in a *ſtate of moiſture*, this objection will not apply: beſides, it appears VITRUVIUS allowed two meaſures of ſea or river ſand to one of lime, and three of pit ſand to the ſame quantity of lime; and that he means *Lime in the Powder* is plain, becauſe he ſays expreſsly, the lime when *quenched* is mixed in the proportion of one to three of ſand, as judiciouſly pointed out to me by Mr. NEWTON, who has tranſlated that ancient author. That VITRUVIUS was not only a judicious, but a *practical* obſerver, as well in regard to *Mortar*, as other articles of building, appears from the diſtinction he makes betwixt *Sharp River* ſand, and *Pit Sand* which is generally ſoft; for of river ſand he allows but two to one of lime: and I have long ſince found the neceſſity of forming a compoſition of fine and coarſe ſand for mortar, unleſs the ſand is naturally ſo mixed; as appears by the firſt note on § 200; for, as the lime will receive the moſt ſand in that way, without loſing its plaſticity, it will of conſequence make the hardeſt and firmeſt mortar. My practice has uniformly been, if there was plenty of one ſort of ſand, and a ſcarcity of the other, to make the mixture, by allowing of the moſt plentiful ſort as far as the proportion of 2 to 1. Dr. HIGGINS not only recommends a mixture of fine and coarſe ſands, but attempts to fix the beſt proportion. *Calcareous Cements*, § 12. beginning page 78. See alſo VITRUVIUS, B. II. Ch. IV. V. and VI.

It may be of uſe, and not out of place, here to obſerve, that, ſo far as I know, it is a *peculiarity* of this gentleman to fix the proportion of

proceeded in the reduction of the expence of *Face* mortar; but as common lime, burnt from a pure lime-ſtone, either hard or ſoft, with an admixture of ſand only, will never acquire a ſtony hardneſs under water, by any treatment I could give it*; and as this is what is generally made uſe of in the back part of the walls, even of works intended to be of the beſt ſort, I was very deſirous to provide a kind of mortar that might not be too expenſive, and yet might internally acquire a ſtony hardneſs. Inſtead therefore of *Tarras* or *Puzzolana*, I ſubſtituted an equal quantity of *Minion*; and as the back part of the walls (or *backing*, as it was called) of the *Calder* works was in general done with *Rubble*, (or rough ſtone from the quarries) where the interſtices were large and open, and required a good deal of matter to fill them them full, I uſed the compoſition already ſpecified, with *common* lime, taking care to ſcreen the pebbles clean from ſand and dirt†; ſo that the whole compoſition would be again increaſed in a greater proportion than that of one to two: we now therefore from every meaſure of unſlaked lime and a meaſure of minion, together with the ſand ſpecified, obtained five meaſures of backing, or (as we called it) *Pebble Mortar*:—— Where minion is not to be had, as a ſubſtitute, if one half, or even one third of its quantity, of tarras or puzzolana is given inſtead of it, it will anſwer nearly as good an end, as a whole meaſure of minion.

203. HAVING thus aſcertained the leading facts with reſpect to the making a compoſition of water mortar for various uſes, it remains a curious queſtion, which being myſelf unable to reſolve, I muſt leave to the learned *Naturaliſt* and *Chemiſt*, why an intimate mixture of clay in the compoſition of lime-ſtone of any kind, either hard or ſoft, ſhould render it capable of ſetting in water, in a manner that no *pure* lime I have yet ſeen from any kind of ſtone whatſoever, has been capable of doing. It is eaſy to add *Clay* in any proportion to a pure lime; but it produces no ſuch effect‡: it is eaſy to add *Brick-duſt*, either finely or coarſely powdered, to ſuch lime, in any proportion, alſo; but this ſeems unattended with any other effect than what ariſes from other bodies that by paſſing the fire become porous and ſpongy, and thereby abſorbents of water, as already hinted; and excepting what may reaſonably be attributed to the irony particles that *red* brickduſt may contain. In ſhort, I have as yet found no treatment of pure calcareous lime, that rendered it more fit to ſet in *Water* than it is by nature, except what is to be derived from the admixture of *Tarras*, *Puzzolana*, or ſome *ferruginous* ſubſtance of a ſimilar nature §.

204. NOTHING

of the ingredients for making mortar by *weight*. I doubt not, but it anſwered *his* end beſt, in point of accuracy in *Experiment*; as he had the management of the preparation of the lime himſelf; but I apprehend this mode will by no means fit the *practical* builder; for, as the Doctor has fully ſhewn, that limes not thoroughly burnt, are conſiderably the heavieſt; it will follow that, by weight, the workman when the lime was bad in quality, would alſo get the *leaſt* of it: and I have in reality known inſtances where the proportions given by Dr. HIGGINS (though clearly enough expreſſed to be *weights*) were applied as meaſures; compounding ſeven *buſhels* of ſand with one of lime!

* Having had the opportunity of taking up a large flat ſtone, of a cloſe grain, of about five feet ſquare, that had probably lain above a *Century* at the bottom of a malt ciſtern, I found it had been well bedded in mortar, which had become coagulated to the conſiſtence of cheeſe; but having never come to a perfect dryneſs, it ſo far retained its natural humidity, that I found it might, with ſome pains, be beaten up to mortar, without any addition of water; and afterwards, being ſuffered to dry in the air, it ſet to a ſtony hardneſs, and appeared as good mortar for dry work, as any which that part of the country produced.

† See the firſt note on § 200.

‡ In the year 1760, having ſome buildings to make for myſelf in a part of the country where the limeſtone is of the more pure kind, and the lime tender and light coloured, I reſolved to try an experiment upon a conſiderable ſcale. I diſſolved clay of the yellow kind (which, when burnt, makes a good hard red brick) in water, in ſuch proportion, as that this water being made uſe of in wetting the quick lime to make it into mortar, it would have ſomewhat leſs than the quantity I had generally found in the blue *Lyas* limes. I at firſt imagined I had made a valuable acquiſition, as the mortar, that from its ſituation was to become dry, ſet very well; but ſome of this clay mortar being uſed where it was likely to continue long in a humid ſtate, though not actually expoſed to water, I found it to ſet very tardily; inſomuch that at the end of three months, I could make an impreſſion upon it with my fingers: however, after a twelvemonth it was tolerably hard; but on examining the building ſo done in the year 1786, I found all the dry work not ſo hard as the mortar of the ſame lime without clay. Some parts of both had equally periſhed, and that in the humid place had acquired but a very moderate degree of hardneſs: it was not in reality, as I judge, near ſo hard as the ſame mortar would have been, if no clay had been introduced; but here no common mortar had been uſed to compare it with.

§ Some years ago M. LORIOT publiſhed a treatiſe upon the compoſition of *Ancient Cements*, with a view to improve the modern. He ſeems

204. NOTHING more directly conduces to the perfection of water mortar, than a means of doing the work with very moderate quantities of it. For theſe purpoſes, it is a firſt principle, that all muſt be *filled full*; but the more *ſtone* there is uſed in a cube yard of maſonry, the leſs room there will be for mortar. I have already deſcribed the methods I made uſe of in *reducing* the *quantity* of the more valuable materials compoſing the mortar for the *Calder* navigation, where the *aſhler* walls were backed, as is generally the practice, with rubble ſtone, or with bricks; but when we came to the upper part of that navigation, in the neighbourhood of *Cromwell Bottom* and *Elland Edge*, being there ſupplied with a ſpecies of ſtone that naturally riſes in *flat beds*, or that can eaſily be ſplit to any thickneſs from two feet to two inches; I found a great utility ariſe from the particular texture of this ſtone, not only in compoſing the *aſhler* part, (which ſcarcely needed any hewing, except a little regulation of the faces and end joints) but alſo in the backing; for the ſtones intended for this uſe being ſorted, and ſuited together, ſo as to form the internal or backing courſes of an *uniform* thickneſs, we were enabled to lay the pieces together, in the manner of a promiſcuous pavement; and theſe being laid down upon a bed of mortar, and the interſtices afterwards made good with ſmall rubble work, to bring to a level and compleat the courſes; by theſe means we were enabled not only to preſerve a firm bond throughout, but to uſe very little mortar in proportion to what we had been accuſtomed to do in common rubble.

205. MY mind had long dwelt upon this idea, without having afterwards an opportunity of putting it in practice; no quarries affording *flat bedded* ſtones having occurred in the proximity of any of my future works; the occaſion was therefore reſerved to my being joined in conſultation with the Gentlemen *Engineers* at *Portſmouth*, as already mentioned; when thoſe gentlemen obſerving the moderate price at which they obtained not only *flat backing*, but *Purbeck* aſhler in rough courſes, from thoſe quarries, the application in the way above mentioned immediately preſented itſelf; and thoſe gentlemen being very attentive to all improvements in the building art, we ſoon found by proper eſtimation, that walls might be built with this kind of ſtone upon this principle, and eſpecially with the uſe of a mortar alſo inveſtigated for that purpoſe, as already mentioned, not only at a leſs price than walls backed with common brick and tarras, but of ſuperior bond and ſolidity * to any thing that has yet been done, except with block ſtone hewn within and without.

I need not acquaint the ingenious artiſt, that more or leſs mortar will be conſumed, in proportion as the flat pieces which compoſe the backing are larger, and brought more cloſely together in the firſt inſtance: but it may be agreeable to him to be informed, that if the ſtones are tolerably bedded, a little work of the hammer will bring them ſo cloſe together, that four cube feet of mortar will be ſufficient to compleat a cube yard of backing.

ſeems to ſuppoſe the *grand ſecret* that has been *loſt*, to conſiſt in the admixture of a certain quantity of the burnt limeſtone unſlaked, and *ground* to a powder, with lime wetted up in large heaps for uſe, as in the common method for large buildings.——I have made trial of this method, both in ſmall and in large; for, however little of likelihood of advantage a propoſition may contain, yet when this concerns a *phyſical* proceſs, nothing can be ſafely concluded, but from actual trial. And I muſt candidly own, that the effect was better than I had expected: for I found the compoſition not only *ſet* more readily than mortar, as commonly made up, but much leſs liable to crack; and conſequently, if this cement was made uſe of in water building, it was leſs apt to re-diſſolve, becauſe, it would more *ſpeedily* get ſet to a firmer conſiſtence, and ſo as more ably to reſiſt the water from entering its pores; but when the water was brought upon it, in whatever ſtate of hardneſs it was at the time, it at beſt but remained in that ſtate, without any further induration, while the water remained upon it; and, as I expect, would ſo remain, till it had had ſome opportunity of acquiring hardneſs by further drying.——M. LORIOT, I perceive, ſtrongly recommends, where *water is concerned*, the uſe of *ſmiths forge ſcales*, and the *refuſe of iron* to be joined with his compoſition; but this I apprehend is no *new* diſcovery of M. LORIOT's, as theſe ſubſtances have been long known to produce a good effect upon all kinds of lime for water building. But after all the experiments I have made, it yet remains a doubt with me, whether, be it for dry works or water works, the uſe of *freſh* ſlaked lime, of whatever kind, as recommended by Dr. HIGGINS, is not preferable to the *ſame* kind of lime treated in M. LORIOT's way. This I am ſure of, that the method of the former gentleman is attended with leſs trouble and expence, as not requiring any part of the materials to be *ground* in a mill, or otherwiſe pulverized.——*Water Lime*, ever ſince I found out the diſtinction, I have always uſed as *freſh* as poſſible, as I was inſtructed at *Watchet*; but in the uſe of common lime, eſpecially for dry works, I had nearly fallen into the common method of wetting it up, till I read M. LORIOT and Dr. HIGGINS.

* Report of Colonel PHIPPS, Lieutenant Colonel MONCRIEF, Captain TWISS of His Majeſty's *Corps* of *Engineers*, and JOHN SMEATON, *Civil Engineer*.

206. BY way of recapitulation and ſum of what I have ſaid upon the article of *Water Cement*, I here ſubjoin a *Table*, containing a ſpecimen of twenty different compoſitions, moſt of which I have uſed in different ſituations, and for different purpoſes.

A TABLE containing Twenty Compoſitions of Water Mortar, ſuited to different Situations and Circumſtances.

N°	*Water Lime* with *Puzzolana.*	Lime Powder.	Puzzolana.	Common Sand.	N° of Cube Feet.	Expence per Cube Foot.
		Buſhels.	Buſhels.	Buſhels.		*s.* *d.*
1	Edyſtone Mortar	2	2	—	2.32	3 8
2	Stone Mortar	2	1	1	2.68	2 1½
3	——— 2d Sort	2	1	2	3.57	1 7½
4	Face Mortar	2	1	3	4.67	1 4
5	——— 2d Sort	2	0½	3	4.17	1 1
6	Backing Mortar	2	0½	3	4.04	0 11
	Water Lime with *Minion.*		Minion.			
7	Face Mortar	2	2	1	3.22	1 5½
8	——— Calder Compoſition	2	1	2	3.57	1 1
9	Backing Mortar	2	0½	3	4.17	0 10
10	——— 2d Sort	2	0½	3	4.04	0 9½
	Common Lime with *Tarras.*		Tarras.			
11	Tarras Mortar	2	1	—	1.67	4 0
12	——— increaſed	2	1	1	2.50	2 9
13	——— further	2	1	2	3.45	2 0½
14	——— ſtill further	2	1	3	4.35	1 8
15	Tarras Backing Mortar	2	0½	3	3.50	1 2½
16	——— 2d Sort	2	0½	3	3.37	0 11½
	Common Lime with *Minion.*		Minion.			
17	Ordinary Face Mortar	2	2	2	2.75	1 5½
18	——— 2d Sort	2	1	3	4.34	0 8½
19	Ordinary Backing Mortar	2	0½	3	4.05	0 8
20	——— 2d Sort	2	0½	3	3.92	0 7½

Obſervations on the preceding Table.

1ſt. Thoſe that would make mortar according to the preceding Table, ſhould know, that the materials are all ſuppoſed to be in a *dry* ſtate when meaſured.

2d. That the lime is ſuppoſed to be thrown into the meaſure with a ſhovel, with ſome *degree* of force; for if put in as light as poſſible, in the way to make the moſt meaſure of it, there will be a want of the real quantity; and if preſſed down, the meaſure will contain conſiderably more than what can be expected in *purchaſing* the material: and the ſame may be ſaid of the puzzolana, the tarras, and the minion.

3d. Reſpecting

3d. Reſpecting ſand, it is particularly to be noted, that if in a moiſt ſtate, the real quantity is conſiderably leſs under the ſame meaſure, than if dry, and that in an *uncertain* degree: and as moiſt ſand is moſt frequently brought for uſe, it is adviſable that the operator ſhould take a means of finding the difference of the proportion, and allowing accordingly in meaſure.

4th. I would alſo obſerve, that, if the ſand is not naturally a compoſition of *fine* and *coarſe*, it ſhould be rendered ſo by an admixture of different ſorts; the proportion of *one* to the *other* need not be much ſtudied; what I have already ſaid in note * on § 202. will be a ſufficient direction.

5th. The due beating of the mortar is however of *great* conſequence; and, without going into that repetition of beating, which has been always looked on as eſſential to the making the common *tarras* mortar, ſuch as N° 11, a degree of beating ſufficient to give it all *poſſible* conſiſtence and toughneſs, before it is uſed, is in reality *indiſpenſible*: and the method that I have found to anſwer the end in the moſt ſatisfactory way is, to mix the due proportion of the lime and the *puzzolana*, the *tarras*, or the *minion*, together in the dry powder; and it will alſo be well, to have at leaſt one third of the *ſand* either fine or coarſe) likewiſe dry: put as much water to the lime, as that with a ſhovel or beater you can bring it to a paſte of a moderate conſiſtence, but rather more wet than to be properly uſed as mortar in that ſtate; then by degrees beat in the moiſt ſand, and afterwards the dry, bringing it to a conſiſtence by beating after every addition. The dry ſand is intended to take up the ſuperfluous moiſture, ſo as to render the mortar immediately fit for uſe; and if this has not brought it to a ſufficient ſtiffneſs, you may let it lie till it inclines to ſet, and then beat it up to the due conſiſtence; or, if immediately wanted, you may beat in a little dry lime powder to drink up the ſuperfluous moiſture; always, however, *faithfully* remembering not to terminate the beating, till the maſs has got *all* the toughneſs that you find it will acquire by beating. This method fully anſwers where *Water Lime* is concerned.

6th. The cuſtomary allowance for tarras mortar beating, firſt and laſt, is a day's work of a man for every buſhel of tarras; that is, for two buſhels of lime powder with one buſhel of tarras; ſo that, by N° 11, if a labourer's day's work (as at London) is rated at 2*s.* then (the buſhel of tarras being valued at 4*s.* the beating will be half the price of the tarras; and the mortar produced being only 12 cube feet, the *beating* of the mortar will therefore amount to 14½*d.* per cube foot: whereas, in the way I have juſt mentioned, a man in *half* a day will beat to a very good conſiſtence the whole produce that can be made, in any of the articles, from two buſhels of *Lime*; ſo that the beating of the beſt face mortar, as N° 4, being 4½ cube feet, will be done for leſs than 2½*d.* at the ſame rate of labour.

7th. In regard to the column of prices, they can only be conſidered as *comparative*: the articles of carriage, dearneſs of particular materials and labour, will greatly vary in different ſituations; but the prices being given as under, at which the different ingredients are rated in the preceding table, the ingenious artiſt will be at no loſs either to compare the different compoſitions with one another; or find the value of them in his own ſituation; or vary them to ſuit his price and purpoſe *.

	s.	*d.*
Water lime per buſhel in the dry powder — — —	0	9
Common lime ditto — — — —	0	4
Puzzolana in powder, prepared — — — —	3	0
Tarras ditto — — — —	4	0
Minion ditto — — — —	1	0
Coarſe or fine ſand, or mixed — — — —	0	2
† The labour of beating two buſhels of common lime to *tarras mortar*, is ſuppoſed	2	0
The labour of beating two buſhels of water lime for thoſe articles —	1	0

* There are many cuſtomary meaſures and ways of meaſuring amongſt workmen, as well as in different counties: when I ſpeak of a *Buſhel*, I would be underſtood to mean the *Wincheſter Corn Buſhel ſtriked*, or the contents reduced to a level with the border.

I alſo ſuppoſe the forge ſcales of iron (when equally powdered, and ſifted clean from dirt and glaſſy ſlags) to be equivalent to as much puzzolana or tarras: ruſt of iron, or iron ore burnt, powdered, and ſifted, to be equivalent to minion; and each of theſe to about half the quantity of puzzolana or tarras: but as the materials themſelves may differ, I would adviſe the curious artiſt to be attentive to the reſult of his *own* trials.——N. B. I ſuppoſe N° 5 equal in firmneſs and validity to N° 11; and N° 10 to N° 15.

† This article of labour is only applied in N° 11, 12, 13, and 14.

BOOK IV.

An Account of Proceedings in the CONSTRUCTION *of the* STONE-*Work, &c. upon the* ROCK, *from the Beginning to the Finiſhing of the Building. With after Occurrences.*

CHAP. I.

Containing an Account of the FIRST YEAR's BUILDING *upon the* ROCK.

207. BY the end of May 1757, we had got every thing in readineſs to carry out the *Neptune Buſs* and begin the Work; it was however the 3d of June before wind and weather ſuited for our getting under way. On that day, being accompanied by Mr. JESSOP, eight ſeamen, the mould-maker, two moorſtone maſons, and ſix tinners, we ſailed out of Plymouth Sound; but it falling calm, we came to an anchor about a league from the rock; and the next morning proving favourable, at ſix we laid hold of the ring of the buoy. We proceeded to heave up the moorings by means of our great tackle blocks, and could we have proceeded at the rate we began, we ſhould have had them up in an hour; but the links of the buoy chain having been made each ſix inches in length, by way of getting faſter forward with the work in making, we found, when theſe links came to a conſiderable ſtrain upon the *davit* roll, which was of caſt iron, and (as mentioned § 127.) not above nine or ten inches in diameter) they began to bend upon the convexity of the roll; and as I was apprehenſive of the ill conſequence that might attend their breaking, the following remedy occurred to me: I ordered the carpenter to cut ſome trenails into ſhort pieces, of about three inches long, and to ſplit each length into two; and thoſe pieces being applied betwixt the chain and the roll at the flexure of each link, as it came to a bearing, prevented the middle part of each link from touching the roll, and therefore its ſtreightneſs and figure could no way be changed by the ſtrain in paſſing over the roll; and the pieces delivering themſelves as the chain cleared the roll, they would ſerve the ſame purpoſe many times over.

The appearance of caution, begets an idea of danger to thoſe who otherwiſe never would have had any apprehenſion of it; and though the riſk of failure was leſſened in a great degree by the propoſed application, as was confeſſed by the whole company, yet it was obſerved, that if the chain *ſhould* break any where between the roll and the tackle, the perſon that applied the pieces of wood would be in danger of being cut in two by the chain, or carried overboard along with it. This being the ſenſe of my ſhip-mates, and as I always made it a rule not to put another upon doing what I was afraid to do myſelf, the *Poſt of Honour* naturally devolved on me; I therefore attended the getting in of the remainder of the eleven fathoms of chain, link by link, till we came to the great ſwivel of the bridle chain: and though this of courſe took ſome time, and left room for ſerious pauſe, yet the conſideration of having previouſly tried the chain by a far greater ſtrain than it was ever deſtined to bear, (ſee § 140.) prevented thoſe reflections from being uneaſy.——This buſineſs having been ſucceſsfully executed, and our addition of five fathoms of large chain applied to the bridle, (ſee § 167.) at twelve o'clock this day, the 4th of June, we found ourſelves once more riding as ſafely and ſecurely at our moorings as we did the laſt ſeaſon.

208. THE

208. THE weather did not admit of our landing that afternoon; but the next morning at eleven we landed, and immediately proceeded with fixing the *Fender Piles* on the eaſt ſide of the rock, which were intended to prevent the boats from rubbing againſt it, according to the idea given thereof, § 83. and as ſhewn in the elevation of the eaſt ſide of the rock in Plate N° 14. We alſo proceeded in fixing up the ſhears and the windlaſs, as ſhewn in the ſame plate; and though we made a conſiderable progreſs the ſame tide, which laſted till four o'clock, yet from the uſual uncertainty of weather, even in the beſt of every ſeaſon, it was the 10th of June before thoſe neceſſary matters were diſpatched; incluſive of the mooring the *Tranſport Buoy*, at eighty fathoms north of the landing-place*, in fourteen fathom water†.——By way of ſeeing that all our tackle acted properly, and as ſome trial of its ſufficiency, we hoiſted the Sea-Horſe yawl, a ſtrong heavy ſhip's long-boat, with ſeveral people in it, upon the top of the rock; and finding every thing to act properly and to be ſufficiently manageable, we were now ready for receiving the ſtone; and the whole company returned home in the yawl, except ſuch hands as were neceſſarily left to take care of the buſs.

209. ON Saturday the 11th of June the firſt courſe of ſtone was put on board the Edyſtone boat, (ſee Plate N° 10. Fig. 1.) with all the neceſſary ſtores, tools, and utenſils; and having appointed Mr. JESSOP, at his own requeſt, to be a foreman in the place of HILL, diſcharged, I took on this occaſion both the foremen, Meſſrs. JESSOP and RICHARDSON, along with me, as alſo the neceſſary hands. We landed at eight on Sunday morning the 12th of June, and before noon had got the firſt ſtone into its place, being that upon which the date of the year 1757 is inſcribed in deep characters‡; and the tide coming upon us, we ſecured it with chains to the old ſtancheons, and then quitted the rock till the evening tide, when it was fitted, bedded in mortar, trenailed down, and compleatly fixed; and all the outward joints coated over with *Plaſter of Paris*, to prevent the immediate waſh of the ſea upon the mortar, (ſee § 174. This ſtone, according to its dimenſions, weighed 2¼ tons.——The weather ſerving at intervals, it was at the evening of Monday the 13th that the firſt courſe, conſiſting of four ſtones, was finiſhed; and which, as they all preſented ſome part of their faces to the ſea, were all of *Moorſtone*.

210. THE next day, Tueſday the 14th, the ſecond courſe, ſee Plate N° 10. Fig. 2. arrived; and ſome of it was immediately landed, proceeded with, and in part *ſet* the ſame tide: the looſe pieces being chained together by ſtrong chains, made on purpoſe for this uſe, and thoſe ultimately to the ſtancheons; or to Lewiſes in the holes of the work of Courſe I. that had already been fixed.——The ſea was uncommonly ſmooth when we got upon the rock, this evening's tide; but while we were proceeding with our work, within the ſpace of an hour and half, the wind ſprung up at N. E. and blew ſo freſh, that the *Weſton*, lying to deliver the remainder of her cargo, had ſome difficulty in getting out of the Gut; and had it not been for the tranſport buoy, to which ſhe had a faſtening by a rope, it would probably have proved impracticable to have got her out again. And we ſoon ſaw it was neceſſary to get every thing in the beſt poſture, time and circumſtances would admit, in order to quit the rock, with ſafety to ourſelves, and ſecurity to what we muſt neceſſarily leave behind us.

The pieces that were fixed and trenailed down, were ſuppoſed to be proof againſt whatever might happen; but the looſe pieces, and thoſe that were ſimply lowered down into their dove-tail receſſes, were conſidered as needing ſome additional ſecurity to prevent their being carried away by the violence of the ſea. Of the thirteen pieces of which Courſe II. conſiſted, five only were landed: N° 1. was compleatly ſet; N° 2 and 3 were lowered into their places, and ſecured by chains; and 4 and 5, which lay at the top of the rock, were chained together, and alſo to the ſlide-ladder, which was very ſtrongly laſhed down

* This was the great buoy that had rode at the moorings during the winter, and was moored by the ſame chain to which it had been faſtened during that ſeaſon: but for this ſervice it had been ſent home and repaired, and was attached to an old anchor of 12 cwt.

† See § 86, and Plate N° 3.

‡ To facilitate the work of getting down the ſtones, after they were landed upon the top of the rock, a kind of frame, ſomething in form of a ladder, was laſhed upon its inclining ſurface, upon which we ſlid the ſtones to their reſpective places.

to eye-bolts, purpoſely fixed on the rock for that intent.——Every moment the wind and ſea ſo increaſed, that it was with the utmoſt difficulty our two yawls could be prevented from being ſtaved upon the rock; and while we were endeavouring to get our tackle-blocks, mortar-buckets, and a great variety of looſe materials and tools, on board the yawls, and to preſerve our utenſils and ſtores; we were riſking the chance, whether we ourſelves ſhould not be left behind to be waſhed off the rock. Our light *ſetting Triangle* *, by which we hoiſted and lowered the pieces of ſtone into their places, as being our greateſt incumbrance, was alſo laſhed to the ſlide-ladder.——Having at laſt got into our yawls, the wind and ſea were ſo increaſed from the N. E. quarter, that we found it quite impracticable to make head againſt it, ſo as to row out of the Gut to the northward; we therefore had no alternative, but, compelled by neceſſity, we riſked our paſſage through the rocks to the ſouthward, aiming at the interval betwixt the Sugar Loaf and the Houſe Reef, (ſee Plate N° 3.) and both boats providentially got through unhurt. We then, having doubled the ſouth point of the Houſe Reef, had to make our way to the north, by the weſt ſide thereof; which, as it was not quite low water at the rocks, afforded us ſome tolerable ſhelter, and gave us time to conſult what to do: for, as the current of the channel tide was then ſetting ſtrongly to the weſtward, and as our buſs lay to the N. E. of the rocks, and of courſe right to windward, there ſeemed a neceſſity for our utmoſt exertions to recover the buſs. We therefore agreed that the light yawl ſhould row the headmoſt, taking the other in *tow*; by which means our united ſtrength could be equally exerted for the benefit of the whole.——Accordingly, when by rowing north we had cleared the Houſe Reef, we ſoon got into ſo much wind, ſea, and current of tide, that we found, notwithſtanding our joint efforts to get to the eaſtward, we were gradually carried to the weſt; and, after a ſtruggle of an hour and an half in this way, we found it quite impracticable for *both* boats to get on board the buſs. Each boat rowed with four oars; Meſſrs. SMEATON and JESSOP, with two ſeamen, and four other hands, were in the light yawl, and Mr. RICHARDSON, one of our beſt ſeamen, and eight other hands were in the Sea-Horſe; which was to make her way weſtward to the *floating Light*, that lay to leeward (ſee § 122): and we in the light yawl determined to endeavour to gain the buſs; and if that could not be effected, alſo to bear away towards the other veſſel.

After labouring at our oars for an hour and an half more, we recovered the buſs, (which lay not much more than 200 fathoms from the place where we parted with the Sea-Horſe) to the great joy of ourſelves, and anxiety for our aſſociates, it then blowing a hard gale of wind, which continued increaſing all night.

About four the next morning the wind ſhifted to the S. E. which produced ſo troubleſome a ſea, that the Weſton, which had rode at the tranſport buoy all night, made ſignals of diſtreſs; and was therefore ordered to *ſlip* and make her beſt port. In the afternoon the wind coming to S. with the tide of flood, the Sea-Horſe returned to the buſs with all hands in ſafety, with grateful hearts for the kind treatment they had received on board the floating light, and for their deliverance; having found the utmoſt difficulty and danger in getting aboard the floating light, on account of the ſea's running ſo high.

211. IN the evening we made a ſhort tide upon the rock, and had the ſatisfaction to find that no material damage had happened to any thing; we therefore proceeded with our work, and compleatly fixed N° 2. of Courſe II: and next morning, Thurſday June the 16th, the Weſton returning from Plymouth, came to the tranſport buoy. We then proceeded both morning and evening tides, though they were not very favourable; and this day ſent home Mr. JESSOP, to prepare himſelf and company to relieve Mr. RICHARDSON's; and for a ſupply of lime and other neceſſaries, of which we were in want. On the morning of Friday the 17th, we again landed for a ſhort time; and, notwithſtanding we did not meet with any thing amiſs on our return to the rock on Wedneſday evening after the hard gale of wind, yet this morning we found a part of the rock in the border of our work, that ſecured a corner of N° 3. was gone: we therefore, to ſecure that ſtone to its neighbour, applied an iron cramp, of which we had ſome in readineſs in caſe of accident.——We were prevented landing in the evening by a freſh of wind

* This Triangle is repreſented as ſtanding upon the wall of the building, ſuppoſed to be raiſed above the vaulted covering of the ſtore-room, Plate N° 14.

and

and rain at N. W. but landed again on Saturday morning's tide, the 18th. However, we had not been long there before a great ſwell aroſe from the S. W.; and, though there had been no wind apparently to occaſion it, yet it came upon us ſo faſt, that we were obliged to quit the rock before we could get our work into ſo ſatisfactory a poſture of defence as I wiſhed. It was, however, as follows, N° 1, 2, 3, 4, and 5, were compleatly fixed as intended; N° 6 and 7 were fitted, and lowered upon their mortar beds; N° 8 was ſimply got into its place, with a weight of lead of five cwt. upon it*; which, in all ſuch trials as had hitherto been made thereof, had lain quietly. Not having time to get the ſtone, N° 9, into its place, we chained it upon the top of the rock to the ſlide-ladder, as we had done before on Tueſday. In this condition we left the rock, having ſtaid till we were all wet from head to foot.——The ſwell continued the remainder of the day, and the wind freſhening at S. W. in the night, at five o'clock on Sunday morning J. BOWDEN made the ſignal of diſtreſs, and was therefore ordered to *ſlip* and go into port.

In the afternoon, on tide of flood, the ſea frequently broke in a large denſe body over the head of the ſhears, which were twenty-four feet in height above the top of rock, and the ſeas running very *ſhort* where we lay, the bowſprit of the buſs ſometimes dipped in the water.——We could plainly ſee the ſtone on the top of the rock till towards the evening, at about high water, when we obſerved ſomething of timber to have broke looſe, and to lie in a wrong ſituation; ſoon after which it diſappeared, as alſo the ſtone; ſo we concluded it was the ſlide-ladder and the ſtone that had gone together.——The next morning, Monday the 20th, the wind was rather increaſed than abated; but no further alteration was apparent on the rock ſince the laſt night.——Towards evening the wind veered to the ſouth, and blew a ſtorm till three o'clock on Tueſday morning, when it began to abate. About nine o'clock it became more moderate; and finding that bread was running ſhort among the workmen, as we were not likely very ſoon to get to work again, I diſpatched the greateſt part of them home in the Sea-Horſe yawl: and about twelve o'clock the wind and ſea having become ſtill more moderate, I judged it practicable to row a-head againſt it, ſo as to get to the weſtward of the rock, and reconnoitre our damages: accordingly, taking four oars in the light yawl, it being then near low water, I obſerved, when the ſea fell away from the rocks, (every ſea then breaking bodily over it) that N° 9, and the ſlide-ladder to which it was chained, were both gone; that the two pieces of moorſtone N° 5 and 6, which had only been let down upon their mortar beds without further faſtening, were alſo gone; that N° 3 had broke its cramp and was gone; and that the 5 cwt. that had been laid upon the moſt projecting part of the piece N° 8, had, by the force of the ſea acting edgewiſe upon it, been driven to the eaſtward till it was ſtopped by the riſe of the third ſtep, againſt which it ſeemed abutted; ſo that having thereby quitted the piece N° 8, upon which it was laid, that was gone alſo: we therefore, as it appeared, had loſt five pieces of ſtone; the loſs of which was in the firſt inſtance alleviated, by finding that the firſt courſe appeared ſo thoroughly united with the rock, that its ſurface begun to look black with dark-coloured moſs fixing upon it, and giving it the ſame hue as the rock itſelf: alſo, that our ſhears and windlaſs were all ſtanding without the leaſt derangement.

I did not wait for the ſubſiding of the winds and ſeas, ſo as to enable us to land, and look out whether or no we could recover any of the loſt pieces; I immediately *made* for Plymouth in the light yawl, and landed at Mill Bay at five o'clock on Tueſday evening the 21ſt; and, having collected the moulds of the ſtones we had loſt, and choſen proper ſpare blocks, I ſet a couple of men to work upon each piece of ſtone, day and night, till finiſhed.——This diſaſter, though it furniſhed a few reflections, yet they were not of the unpleaſant kind; for, as every part of the ſtone-work, that was *compleated* according to its original intention, appeared to have remained *fixed*, it demonſtrated the practicability of the method choſen; and at the ſame time ſhewed the preference of wedging to cramping, as the cramp had failed: and alſo the utility of trenails† as a ſecurity till the mortar was become hard.

* This weight, which was in the ſhape of the ſegment of a ſphere, I had got prepared, as a means of holding down ſuch ſtones as were ſimply lowered into their receſſes, and which for want of time could not be got fixed in a more effectual manner; for, from the figure thereof, its baſe or flat ſide being laid upon the flat ſurface of the ſtone, the action of the ſea could have very little hold upon it, being all a ſmooth ſurface, the ring excepted.

† The method of trenailing and wedging will be fully deſcribed in its due place.

In

In leſs than two days the five pieces of ſtone were compleated; and on Thurſday the 23d in the evening I went on board the Weſton with the ſtones, carrying alſo Mr. JESSOP and company; but there being little wind, we were obliged to row all night; and when, by this labour, we had got within a league of the buſs, it began to blow ſo hard at E. that we thought it adviſable to bear away for ſome weſtern port. Accordingly at ſeven in the morning we came to an anchor in Fowey harbour; and that day took the opportunity of viewing the progreſs of our moorſtone works at *Lanlivery*. The wind continued freſh at E. the next day; and as the day after, being Saturday the 25th, it again became RICHARDSON's turn to go out, I ordered BOWDEN to beat to windward, if poſſible, and get to his moorings at the tranſport buoy, as ſoon as he could; and with Mr. JESSOP and his company, returned over land to Plymouth.

212. AT four o'clock on Monday morning the 27th, the weather ſerving, I went out with RICHARDSON and company, in the Edyſtone boat; we got to the buſs at ten, and found the Weſton at the tranſport buoy, but could not land till the afternoon's tide, being a compleat week ſince we had been laſt upon the rock. We firſt replaced the ladder, and afterwards proceeded, without more than uſual interruptions, till the 30th in the evening, when we cloſed and compleated the Courſe N° II. and began upon Courſe III.——The execution of theſe two courſes had taken us up from the 12th to the 30th incluſive, and though they conſiſted of no more than ſeventeen pieces of ſtone in the whole, yet I found myſelf no ways *diſheartened*; for, in eſtabliſhing theſe two courſes, I conſidered the moſt difficult and arduous part of the work to be already accompliſhed, as theſe two courſes brought us up to the ſame level where my predeceſſor Mr. RUDYERD had begun.

While the new ſtones of Courſe II. were making, I received intelligence from the buſs, that the ſeamen there, during our abſence, had been into the Gut, and had obſerved ſome of the pieces we had loſt to be lying in the bottom of it: I therefore, beſides forming new pieces, ordered an utenſil to be made, by means of which it ſeemed likely I might get ſome of theſe pieces up again: and though all the new ſtones were landed and ſet in their places before I had an opportunity of trying the tool; yet I was willing to convince myſelf, how far it might be uſeful upon any future ſimilar occaſion.——Accordingly, between the tides of the 30th, (the water falling away ſo as to leave only ten feet depth in the Gut) I made a trial of the inſtrument*, wherewith I ſucceeded in getting up one of the ſtones, which proved to be N° 9, that was chained to the ladder at the top of the rock; and I might have got up two others that lay there, had they been wanted; but the mere recovery of ſtones, after a ſufficient experiment had been made, was ſcarcely worth the time.

The next day, Friday July the 1ſt, we were able to land; but as the wind blew freſh at S. W. I judged it unſafe to bring the Edyſtone boat into the Gut to deliver any ſtone. I obſerved, that during the laſt tide, the ſwell had waſhed ſome of the pointing out of the exterior joints, and alſo ſome of the grouting out of the upright joints; but as a heavy ſea ſeemed likely to come on with the tide of flood, I judged it to be to no purpoſe to repair the cement while a *violent* ſwell continued; I therefore employed the company in cutting off the iron ſtancheons belonging to the former building, as they now began to be in our way, and as the *hold* we got of them ceaſed to be of uſe, in proportion as we got more faſtening from the lewis holes of our own work.——It was not long before the maſter of the Edyſtone boat gave warning, he could lie no longer at the tranſport buoy; I therefore took my paſſage on board of it to Plymouth, and landed in the afternoon.

213. THE weather having become more favourable, on Sunday morning the 3d of July, I went on board, accompanied by Mr. JESSOP, and his party, to whom, as they had never had the opportunity of ſetting a ſtone, it behoved me to attend. We however not only met with a repulſe this day, but could not make any further attempt to go out till Tueſday the 5th; and then the wind, though gentle, being contrary, had not the company on board the buſs come with their two yawls and towed us thither, in all probability the day would have been ſpent in fruitleſs attempts. Our difficulty was conſiderably increaſed by the

* See the explanation of this inſtrument, amongſt the tools and utenſils contrived or adapted to the Edyſtone works, in Plate N° 18.

coming

coming on of ſo thick a fog, that all our efforts united, we had much ado to regain the buſs.——RICHARDSON told me they had had ſuch bad weather, that the ſlide-ladder had again broke its laſhings and driven away; that they had however got all the irons cut off cloſe to the rock; but that the laſt tide, though there was only a breeze at S. W. the ſwell was ſo great, and came on ſo ſuddenly, as to put them in great danger of being waſhed off from the top of the rock, before they could quit it.

At two o'clock this day we landed, and JESSOP's company ſet ſix pieces of ſtone, and effectually repaired the cement; and next day a proportionable diſpatch was made, though the weather was not very mild.——In the night, betwixt eleven and twelve o'clock, the watch upon deck eſpied a ſail upon the rocks; whereupon we immediately ſent one of our yawls to her relief; which ſoon returned with the whole crew, ſeveral of whom were in their ſhirts, and in great diſtreſs. They informed us that the veſſel was the *Charming Sally* of *Biddeford*, a ſnow of 130 tons burthen. They had been at *Dartmouth*, from whence they were returning in ballaſt; and as there was no ſtreſs of weather at that time to drive them upon the rocks, we could not but wonder how they had contrived to get *thither*: we were informed, that not knowing exactly where they were, they took the rocks to be ſo many fiſhing-boats, till it was too late to clear them; and that on the veſſel's ſtriking, ſhe filled ſo quick that the boat floated upon the deck before they could get into it. In ſteering weſtward, ſhe had cleared the ſouth point of the ſouth-eaſt reef, and fell upon the ſouth reef near the higheſt part. See Plate N° 3.——The veſſel ſat almoſt upright upon the rocks, and the maſts remained ſtanding the whole of the day; but in the night following ſhe was wholly beaten to pieces.——Her crew, conſiſting of ſeven hands, having been refreſhed on board the buſs, the next day rowed off in their boat to *Looe*; and as we had not landed ſince the 8th, nor now more likely, I took the opportunity of returning to Plymouth in a Cawſand fiſherman, who came with an intent to pick up ſomething from the wreck; in which however he was diſappointed.

214. ON Monday the 11th I again went out with RICHARDSON and company; Courſe III. conſiſting of twenty-five pieces, was cloſed on the following day, and Courſe IV. begun.——The tide of the 13th in the evening was remarkably quiet, and allowed us to go on with our work uninterruptedly; but juſt after we had got on board the buſs, a ſudden ſquall of wind aroſe from the S. W. which at once threatened a moſt dreadful ſtorm; and it blew ſo hard, that we expected the maſt to go by the board; but before the neceſſary orders could be given, by way of preparation, it became a perfect calm; the ſquall not having continued more than a minute, as it ſeemed to us. This was followed with a breeze from the eaſt, and frequent flaſhes of lightning till the tide of ebb.

Thurſday the 14th of July the company purſued the work of Courſe IV; and now both companies being fully inſtructed in the method of ſetting the baſement courſes, I returned to Plymouth; from whence I propoſed to viſit each company as often as ſhould ſeem expedient, but always once in each company's *turn*, if wind and weather ſhould permit.

215. I WENT out with JESSOP's company on Monday the 18th; but we were repulſed by bad weather, which continued to the 23d. The 21ſt, RICHARDSON's company having almoſt exhauſted their proviſions, and not being likely to get any ſupplies, came home in the Sea-Horſe yawl: and gave account, that a few days before they came home, in hoiſting one of the ſtones out of the veſſel upon the rock, by neglecting to belay the tackle-fall of the *out-hawler Guy*, the ſhears came down flat upon the rock in the midſt of the men, but providentially without doing any harm to either men or ſhears. He alſo acquainted me that they had had the greateſt ſwell from the ſouth they ever experienced, and that the 500lb. weight had been waſhed from the work, but that they had found it entangled in the rocks above low water mark.

About this time I had intelligence from Portland, that two veſſels laden with ſtone for the Edyſtone, waiting a favourable opportunity to ſail for Plymouth, had all their hands preſſed by the lieutenant of a tender ſtationed there; notwithſtanding the ſervice they were upon, and their having on that account Admiralty protections. This circumſtance would have proved very diſtreſſing, had not the Lords of the

Admiralty, on application, ſent immediate orders, by expreſs, for diſcharging the men: and it is a great ſatisfaction to me when I ſay, that on this, as well as on every other occaſion, we found the *Admiralty* Board was ready and diſpoſed to give all the furtherance to our work in their power; though we did not always find that countenance from their ſervants.

216. CONTRARY winds, ground ſwells, and heavy ſeas for ſeveral days, interrupted the regularity of our proceedings; however, taking ſuch opportunities as we could, the Courſe N° IV. conſiſting of twenty-three pieces of ſtone, was cloſed, in the morning's tide of the 31ſt of July, (ſee Plate N° 10): and in the evening's tide five pieces of Courſe V. were ſet.——Our work went on regularly for ſome days together; and on viſiting the work upon the 5th of Auguſt, I found the Courſe N° V. containing twenty-ſix pieces, cloſed in, (ſee Plate N° 10); but that by ſome inadvertency in proceeding with the interior part, the maſons had been obliged to ſet two of the outſide pieces ſo as to be further out than they ſhould have been by an inch each. However, as I found the work was ſound and firm, I thought it better to cut off the ſuperfluous ſtone from the outſide, than to diſturb the work by the violence that muſt have been uſed in unſetting the pieces; I therefore determined to let them ſtand as they were, till the cement was become ſo hard as to ſupport the edges of the ſtone while the faces were working afreſh; and which, from the mortar of our firſt and ſecond courſe, we found was likely to be the caſe before the cloſe of the ſeaſon. ——One of the dovetails had alſo given way in driving a trenail, owing to a flaw in the ſtone; for the remedying whereof we applied a cramp.

This day our additional boat, that had for ſome time been fitting out, called the *Aſſiſtant*, and of which I appointed SAMUEL MEDLING to be maſter, brought out and landed at the rock her firſt cargo of ſtone, containing a part of Courſe VI. ſome of which were proceeded with and ſet: the Edyſtone boat alſo arrived with another cargo of lime and puzzolana, as well as ſtone, and came to the tranſport buoy; but the wind beginning to blow hard, ſhe was obliged to look out for a harbour.——At this time we were in greater want of lime and *Puzzolana*, than of ſtone; and as nothing could proceed without theſe neceſſary materials, and it being uncertain when the boat might return, I contrived as follows to get a caſk of each on board the buſs before ſhe left us.——The ſea was ſo hollow and tumultuous, that though it was practicable for the light yawl to row near enough to throw a ſmall rope on board the boat, yet it was impracticable for the yawl to receive any thing of weight over her ſide without danger of filling. I therefore ordered W. SMART, the maſter of the boat, to laſh a caſk of each to the ſhrouds with *Spun Yarn*; ſo that when the laſhing was cut, either of the caſks might inſtantly go overboard. A ſmall rope from the buſs having been fixed to each, and the laſhings ſucceſſively cut at a favourable moment, the caſks immediately fell into the ſea, and were eaſily towed on board the buſs, the materials not ſuffering any material injury by being wet with ſea water: and this expedient proved of the more value, as by this means we proceeded with the work of Courſe VI. ſeveral tides ſooner than otherwiſe we could.

217. THE 8th of Auguſt at noon, the weather being exceeding fine, with a low neap tide, I took the opportunity of drawing a *meridian* line upon the platform of Courſe VI. the ſea never going over the work during the whole tide, which was the firſt time it had not waſhed *over all*, ſince we began to build: we therefore took this favourable opportunity of carefully making good all our *pointings* and *groutings*, wherever the water had waſhed during the bad weather that had ſucceeded the laſt departure of the Edyſtone boat; and which was the caſe with it in places where it had not had time, to ſet before a rough tide came on; but I obſerved with much ſatisfaction, that whatever, not only of the original work, but of the repaired pointing, had once ſtood a *rough* tide, without giving way, the ſame place never after failed. ——I alſo obſerved, that as in mending the pointings we had in ſome places made trial of Dutch tarras as well as puzzolana, interchangeably, the puzzolana, for hard ſervice, was evidently ſuperior to the tarras: and ſome particular joints had proved ſo difficult, that I was obliged to try other expedients; the beſt of which was to chop *Oakum* very ſmall, and beat it up along with the mortar. This was our *laſt* reſource, and it never failed us.

218. ON

218. ON landing at Mill Bay, the 9th of Auguſt, I had the ſatisfaction to find four veſſels arrived from Portland with ſome pieces of ſtone, which their detention had cauſed us to be much in want of. Upon the 11th I again went out in the veſſel that contained the remaining pieces of Courſe VI; thoſe I ſaw fixed; and that courſe, conſiſting of thirty-two pieces, cloſed in, the ſame evening. See Plate N° 10.——This compleating our ſix baſement courſes, brought our work upon the ſame level to which we had, the preceding ſeaſon, reduced the top of the rock; and upon this, as a common baſe, the reſt of the ſtructure was to be raiſed by regular entire courſes.——The time this part of the work (conſiſting of 123 pieces of ſtone) had taken up, was from the 12th of June to the 11th of Auguſt inclusive, being a ſpace of ſixty-one days. We now conſidered our greateſt difficulties to be ſucceſsfully ſurmounted, as every ſucceeding courſe had given us more and more time, as well as more and more room; and this will appear from our proceedings; for it has already been noticed that the firſt two courſes, conſiſting of nineteen pieces of ſtone only, had coſt us ſeventeen days.

219. HAVING now got the work to this deſirable ſituation, I apprehend it will be agreeable to my reader, to be more particularly acquainted with the method in which the ſtones were ſet and fixed. ——I have intimated § 151, that when each ſeparate piece, of which a courſe was to conſiſt, was ſeparately wrought, they were all to be brought to their exact places with reſpect to each other upon the platform in the work-yard, and ſo marked, that after being numbered and taken to pieces, they could again be reſtored to the ſame relative poſition. This was done upon the compleat circular courſes by drawing lines from the center to the circumference, paſſing through the middle of each ſet of ſtones; and likewiſe concentric circles through the middle of each tier or circle of ſtones, ſo as to indicate to the eye their relative poſition to each other: but to render the marks not eaſily delible, where thoſe lines croſſed the joints, a *nick* was cut and ſunk into the ſurface of the two adjacent ſtones; for doing which, a piece of thin plate iron was employed, with ſand, upon the principle that ſtones are ſawn; ſo that not only the ſight, but feeling, could be employed in bringing them together again exactly; for the ſame or a ſimilar plate being applied to the nick, the leaſt irregularity of its poſition would be diſcoverable.——In a ſimilar manner the ſtones of the *Baſe Courſes* were marked by lines drawn parallel to the length of the ſteps, and others perpendicular to the ſame, the croſſings being ſawn in as before deſcribed. There was, however, a nicety in this part of the work that required particular attention, and that was in forming a proviſion for ſetting the four *radical* ſtones, that occupy the four *radical* dovetails into which each ſtep was formed, as may be obſerved in the ſeveral figures of Plate N° 10.——Thoſe ſtones were formed, from the work of the rock's being actually moulded off, as mentioned § 159: and from the manner already deſcribed of bringing thoſe moulds to agree after they were brought home from the rock, § 160, thoſe ſtones were laid upon the platform thereby, and then marked with lines upon their own ſubſtance, in the manner juſt mentioned: and as the diſtances of each of thoſe ſtones were then aſcertained by gauge-rods of white fir-wood, while upon the platform; it muſt be expected, as each ſtep was reduced to a level plain, as the platform was, that when laid upon the rock in their due poſitions and diſtances, by the gauge-rods, they would nearly fit the dovetails that had been cut in the rock to receive them; and where there was the leaſt want of fitneſs, as might poſſibly happen with bodies of ſo rigid a nature, either the ſtone or the rock was cut, till each ſtone would come into its exact relative poſition, and then all the reſt would follow one another by their marks, in the ſame manner as they had done upon the platform.

220. IT is neceſſary to be noticed, that the waiſt of each piece of ſtone had two grooves cut, from the top to the bottom of the courſe, of an inch in depth, and three inches in width: applicable to thoſe grooves, were prepared a number of oak wedges, ſomewhat leſs than three inches in breadth, than one inch thick at the head, nearly $\frac{1}{4}$ths thick at the point, and ſix inches long. The diſpoſition of theſe grooves is ſhewn in the courſes of Plate N° 10, where the little black parallelogram figures, placed along the lines deſcribing the joints of the courſes, repreſent the tops of the grooves, and their place on the right hand or left of the joint line, ſhew in which ſtone the groove is cut. It is alſo to be noted, that where the flank ſide of

a ſtone

a ſtone was not more in length than a foot or fourteen inches, one groove was generally deemed ſufficient; but thoſe of eighteen inches or upwards had generally, in themſelves or the adjoining ſtone, a couple of grooves.

221. THE mortar, which was compounded as ſhewn in § 188*, was prepared for uſe by being beat in a very ſtrong wooden bucket made for the purpoſe; each mortar-beater had his own bucket, which he placed upon any level part of the work, and with a kind of rammer or wooden peſtle†, firſt beat the lime alone, about a quarter of a peck at a time, to which, when formed into a compleat, but rather thin paſte with ſea-water, he then gradually added the other ingredient, keeping it conſtantly in a degree of toughneſs by continuance of beating.——When a ſtone had been fitted and ready for ſetting, he whoſe mortar had been longeſt in beating came firſt, and the reſt in order: the maſon took the mortar out of the bucket; and if any was ſpared, he ſtill kept on beating; if the whole was exhauſted, he began upon a freſh *Batch*. ——The ſtones were firſt tried, and heaved into and out of their receſſes, by a light moveable triangle, which being furniſhed with a light double tackle‡, the greateſt number of all the pieces could be purchaſed by the ſimple application of the hand; and this made our ſtones to be readily manageable by ſuch machinery as could commodiouſly be *moved* and carried backward and forward in the yawls every tide. To the firſt ſtone, and ſome few others, we took the great tackle, that we might hoiſt and lower them with certainty and eaſe; but there were not in the whole above a dozen of ſtones that required it.

222. THE ſtone to be ſet being hung in the tackle, and its bed of mortar ſpread, was then lowered into its place, and beat down with a heavy wooden maul, and levelled with a ſpirit level‖: and the ſtone being brought accurately to its marks, it was then conſidered as ſet in its place. The buſineſs now was to *retain* it exactly in that poſition, notwithſtanding the utmoſt violence of the ſea might come upon it before the mortar was hard enough to reſiſt it.——The carpenter now dropped into each groove two of the wedges already deſcribed, one upon its *Head*, and the other with its point downward, ſo that the two wedges in each groove would then lie *Heads and Points*. With a bar of iron of about 2½ inches broad, ½ of an inch thick, and 2½ feet long, the ends being ſquare, he could eaſily (as with a rammer) drive down one wedge upon the other, very gently at firſt, ſo that the oppoſite pairs of wedges being equally tightened, they would equally reſiſt each other, and the ſtone would therefore keep its place; and in this manner thoſe wedges might be driven even more tight than there was occaſion for; as the wood being dry, it would by ſwelling become tighter; and it was poſſible that by too much driving, and the ſwelling of the wedges, the ſtones might be broken: and further, that a moderate faſtening might be effectual, a couple of wedges were alſo, in like manner, pitched at the *top* of each groove, the dormant wedge or that with the point upward, being held in the hand, while the drift wedge or that with its point downward, was driven with a hammer; the whole of what remained above the upper ſurface of the ſtone was then cut off with a ſaw or chiſſel; and generally, a couple of *thin* wedges were driven very moderately at the but-end of the ſtone; whoſe tendency being to force it out of its dovetail, they would, by moderate driving, only tend to preſerve the whole maſs ſteady together; in oppoſition to the violent agitation that might ariſe from the ſea.

223. AFTER a ſtone was *thus* fixed, we never in fact had an inſtance of its having been ſtirred by any action of the ſea whatever; but conſidering the unmeaſured violence thereof, the further ſecurity by trenails, ſuggeſted § 163, and now prepared, will not ſeem altogether unneceſſary, when we reflect, that after a ſtone was thus fixed in its place by wedges, a great ſea coming upon it, often in leſs than half

* See alſo N° 1. of the Table in § 206.

† See deſcription of tools and utenſils, Plate N° 18. ‡ See alſo deſcription, Plate N° 17.

‖ Thoſe were provided on purpoſe, being ſuch as were uſed § 81. and ſaved much loſs of time that would otherwiſe have attended the uſe of levels with *Plumbets*, which, (as far as I know) were the only ones then uſed in maſonry.

an

an hour) was capable of waſhing out all the mortar from the bed underneath it, notwithſtanding every defence we could give it by plaſter or otherwiſe; and that when the bed of mortar was deſtroyed, the ſea acting edgewiſe upon the joint would exert the ſame power to lift it up, that the ſame ſea would exert to overſet it, in caſe its broad baſe was turned upright to oppoſe it; and as the wedges only fixed and ſecured the ſeveral pieces of which each courſe conſiſted to each other, and had no tendency to keep the whole courſe from lifting together, in caſe the whole ſhould loſe its mortar bed; it ſeemed therefore highly neceſſary to have ſome means of preventing the lifting the whole of a courſe together, till the ſolidity and continuity of the mortar ſhould totally take away that tendency.——Adverting now to what was ſaid § 163, that a couple of holes, to receive oak trenails of an inch and ½ in diameter, were bored in the work-yard through the external or projecting end of every piece of ſtone; we muſt now ſuppoſe theſe ſtones ſet in their places and fixed by wedges; then one of the tinners with a *Jumper* began to continue the hole into the ſtone of the courſe below, and bored it to about eight or nine inches deep; but this hole was bored of a leſs ſize, by $\frac{1}{16}$ of an inch in diameter, than the hole through the ſtone above*; in conſequence, the trenails having been previouſly dreſſed with a plane till they would drive ſomewhat freely through the upper hole, would drive ſtiffly into the under one, and generally would become ſo faſt as to drive no further before their leading end got down to the bottom; and if ſo, they were ſufficiently faſt: but as they ſometimes happened to drive more freely than at others, the following method was uſed to render them faſt, for a certainty, when they got to the bottom.——The leading end of every trenail was ſplit with a ſaw for about a couple of inches, and into this ſplit was introduced a wedge about $\frac{1}{16}$ of an inch leſs in breadth than the diameter of the trenail; it was a full quarter of an inch in thickneſs at the head, and ſharpened to an edge: when therefore the head of the wedge touched the bottom of the hole, the trenail being forcibly driven thereupon, would enter upon it, till the whole ſubſtance was jambed ſo faſt, that the trenail would drive no further; and as the wood would afterwards ſwell in the hole, and fill the little irregularities of boreing by the jumper, it became ſo faſt that, as it ſeems, they could ſooner be pulled in two than the trenails be drawn out again†. The trenail (originally made ſomewhat too long) being then cut off even with the top of the ſtone, its upper end was wedged croſs and croſs.——There being generally two trenails to each piece of ſtone, no aſſignable power, leſs than what would by main ſtreſs pull theſe trenails in two, could lift one of theſe ſtones from their beds when ſo fixed, excluſive of their natural weight, as all agitation was prevented by the lateral wedges.—— The ſtone being thus fixed, a proper quantity of the beat mortar was liquefied, as mentioned § 183, and the joints having been carefully pointed up to the upper ſurface, the *Grout* ſo prepared was run in with iron

* The jumpers were kept to the ſame gauge by means of two braſs rings turned to the proper ſize; ſo that when the jumpers by wearing became too little, they were ſent to the ſmith to be made to their full ſize, by the hammer, according to the gauge ring referred to.

† It probably may be a ſatisfaction to the practical reader, as this mode of fixing by trenails may be uſeful on many occaſions, to have ſome ſort of proof of what is here advanced. He will remember the caſe of the *ſtemming* a hole for *blaſting* rocks with gunpowder; that, after the proper quantity of powder is in, the ramming the hole, for five or ſix inches above the powder, with dry clay, or even the very powder of the ſtone that has been cleared out of the hole in boring, will, on firing the powder, produce ſo compleat a reſiſtance, that the rock will ſooner be ſplit in another direction than the ſtemming will be driven out of the mouth of the hole. Now this does not happen becauſe the ſtemming is of more ſolid or tenacious matter than the rock itſelf, but becauſe the power to drive it out can act only upon the *end* of it, equal to the area of the circle of the hole; whereas the *hold* by which the ſtemming (or *wad*) is retained in the hole takes place in every point of the ſurface of the cylinder that it occupies. As for inſtance, ſuppoſe the hole to be 1¼ inch diameter, then the area of it is nearly one ſquare inch; and ſuppoſe the length of the cylinder occupied by the wad to be 6 inches, then the circumference of a circle, whoſe area is one ſquare inch, being 3⅝ inches nearly, the circumference of the whole cylinder ſo engaged will be 21 ſquare inches; ſo that it would require a force 21 times greater than that whereby the matter of the *Wad cohæres* to the ſolid, to diſlodge it from the hole lengthwiſe.——I do not find an inſtance in my Journal, nor does my memory furniſh me with one, wherein the neceſſity occurred of getting any trenail out again after it had been driven; had that happened, it muſt have been bored out again, as I know of no force that could have been applied, which would have drawn it out.

Having mentioned the affair of blaſting, it perhaps may not be amiſs here to add, that the efficacy of the gunpowder to ſplit the ſtone, rather than to drive out the ſtemming or wad, is greatly owing to a further circumſtance. The force of the powder to drive out the wad is only in proportion to the area of the hole; whereas its power to divide the ſtone in a direction parallel to the hole, is as the area of a parallelogram formed by the diameter of the hole, multiplied by the length that the charge occupies; that is, the diameter of a hole whoſe area is one ſquare inch, being 1⅛ nearly, if the length is 6 inches, the product will be 6¾; and ſo many times is the force that the ſame charge of powder exerts to ſplit the ſtone, more than that to drive out the wad. Beſides, every force exerted to drive the wad out of the hole, probably tends to make it take the ſtronger hold, in conſequence of the parts of it being jambed harder together, as the force is greater.

ladles, and was brought to ſuch a conſiſtency as to occupy every void ſpace; and though a conſiderable part of this was water, yet that being abſorbed by the dry ſtones, and the more conſiſtent parts ſettled to the bottom, the vacuity being at the top, this was repeatedly refilled till all remained ſolid: the top was then pointed, and, when neceſſary, defended by a coat of plaſter.

The ſeveral courſes repreſented in Plate N° 10, are ſhewn as they would appear, when compleated with the whole of their wedges and trenails: and beſides theſe, there being alſo generally two *Lewis* holes upon the upper ſurface of each ſtone, thoſe ſerved as temporary fixtures for the work of the ſucceeding courſe.

224. IT was the ſame evening's tide of the 11th of Auguſt, that the baſement was compleated and the center ſtone of Courſe VII. was landed.——Of the preceding courſes, each was begun by the ſtones that engrafted in the dovetail receſſes cut in the rock; theſe ſtones therefore being immoveable by any aſſignable force acting horizontally, rendered thoſe ſo likewiſe that depended upon them; but having now brought the whole upon a level, we could not have this advantage any longer; it therefore became neceſſary to attain a ſimilar advantage by *artificial* means.——For this purpoſe the upper ſurface of Courſe VI. (ſee Plate N° 10. Fig. 6.) had a hole of one foot ſquare cut through the ſtone that occupied the center; and alſo eight depreſſions of one foot ſquare, ſunk into that courſe ſix inches deep, which were diſpoſed at regular diſtances round the center, as is ſhewn in that figure: theſe cavities were for the reception of eight cubes of marble, in maſonry called *Joggles**.——As a preparation for ſetting the center ſtone of Courſe VII. a *parallelopiped* (which for ſhortneſs ſake I will call the *Plug*) of ſtrong hard marble from the rocks near Plymouth, of one foot ſquare and twenty-two inches in length, was ſet with mortar in the central cavity, and therein firmly fixed with thin wedges. Courſe VI. being thirteen inches in height, this marble plug, which reached through, would riſe nine inches above it; upon this, the center ſtone (ſee Plate N° 11. Courſe VII.) having a hole through its center of a foot ſquare, was introduced upon the prominence of the plug, and being bedded in mortar, was in like manner wedged (with wedges on each ſide the plug) and every remaining cavity filled with grout. By this means no force of the ſea acting horizontally upon the center ſtone, leſs than what was capable of cutting the marble plug in two, was able to move it from its place: and to prevent the ſtone more effectually from being *lifted*, in caſe its bed of mortar happened to be deſtroyed, it was fixed down in the manner above deſcribed, by *four* trenails; which being placed near to the corners of the large ſquare of that ſtone, they not only effectually prevented the ſtone from lifting, but aided the center plug in preventing the ſtone from moving angularly or *twiſting*, which it might otherwiſe have done, notwithſtanding its weight, which was two tons nearly†.

225. WHILE the center plug of this courſe was preparing to be fixed, an accident happened, which, without ſome preſent reſolution, might have prevented my ſeeing the firſt ſtone placed. The level platform we then had obtained being ſomething of a novelty, I was enjoying it by walking to and fro upon it; by ſome inattention I made a falſe ſtep into one of the eight cavities for the *Joggles*, and not being able to recover myſelf, tumbled over the brink of the work down among the rocks on the weſt ſide; but the tide being then retreated, I preſently recovered my former ſtation, at firſt ſuppoſing myſelf but little hurt; but ſoon finding a very great and unuſual numbneſs in one of my thumbs, on looking upon it, I perceived, from its irregular direction, it was put out of joint. I reflected that I was at leaſt fourteen miles from a ſurgeon, and as far back again, and both ways ſubject to the uncertainty of winds and ſeas; I therefore laid faſt hold of it with the other hand and gave it a violent *pull*, upon which it ſnapped into its place; and I immediately proceeded to fix the plug. I had not much pain or uneaſineſs from it the firſt tide; but it was above ſix months after this accident, before I could make free uſe of it.

* When a ſmaller piece of ſtone, of any ſhape or kind, is let in between two larger ſtones, and partly into one, and partly into the other, ſo as to prevent their ſhifting place with reſpect to each other, thoſe pieces of ſtone are termed *Joggles*.

† An Edyſtone ſilver medal (ſee Plate N° 18.) was laid under the center ſtone, together with ſeveral pieces of money.

226. AFTER

226. AFTER ſetting the firſt center ſtone of Courſe VII. we immediately proceeded to ſet the four ſtones that ſurround it, and which were united thereto by four dovetails, projecting from the four ſides of the center ſtone. Theſe ſtones being fixed in their dovetails by a *pair* of wedges on each ſide, at bottom and top, as has already been mentioned, and held down by a couple of trenails to each ſurrounding ſtone, and ſtill further ſteadied by joint wedges at the head of the dovetails, and alſo in the *mitre* or *diagonal* joints betwixt each ſurrounding piece; the whole formed a circular kind of ſtone of ten feet diameter and above ſeven tons weight: and which being held down by a center plug and twelve trenails, became in effect one ſingle ſtone; whoſe circumference was ſufficient to admit of eight dovetail receſſes to be formed therein, ſo as to be capable of retaining in their places a circle of eight pieces of ſtone of about 12 cwt. each, in the ſame manner and upon the ſame principle, that the *radical* pieces of ſtone were engrafted into the dovetail receſſes of the rock; and which being in like manner wedged and trenailed, we proceeded with circular *Tiers* of ſtone, in the manner ſhewn in Plate N° 11. Fig. 1.——It is however to be remarked, that the mode of applying the wedges and trenails being ſufficiently explained in the ſeveral figures of Plate N° 10. and alſo in Plate N° 11. Fig. 1. to avoid a repetition of ſmall work, the ſeveral ſucceeding figures ſimply ſhew the general ſhapes and diſpoſition of the different pieces compoſing a courſe, and other incidental larger matters, wholly omitting the particular application of the wedges and trenails; yet it is to be obſerved that they were every where equally applied, till we got to the *top* of the *Solid*.

227. WE went forward with Courſe VII. without any thing but common interruption for ſome days.——It was remarked that upon the 12th of Auguſt, the wind being eaſtwardly, and moderate, there was the greateſt ſwell in the Gut that we ever had experienced, when we attempted to land ſtones; the boat roſe and fell full four feet perpendicular, which rendered the management of it, and landing of the pieces extremely difficult; and had not our *purchaſes* been very ſpeedy in their action as well as forcible, we could not have done it at ſuch a time; for after a ſtone was raiſed from the floor of the boat, the boat would riſe under the ſtone ſo as ſometimes to unhook it from the tackle, yet happily the boat ſuſtained no damage: and having now ſeen the five ſtones of the center compleatly eſtabliſhed, I left RICHARDSON and company, after ſetting the firſt of the third tier, to compleat and go on with the reſt in the ſame manner.

228. MY much eſteemed maſter and friend Mr. WESTON, who came from London to be witneſs of our proceedings, arrived at Plymouth during this interval. I went off with him early on Wedneſday morning the 17th, attended by Mr. JESSOP and his company, and landed upon the rock at ten; RICHARDSON and company were then about to begin to ſet the fifth tier, or circle of ſtones which was to contain the eight cubes before deſcribed.——Theſe cubes were ſo diſpoſed upon the ſurface of Courſe VI. that the cavities cut on the under ſide of Courſe VII. to take the upper half of each cube, ſhould conſtantly fall in the broad part of the ſtones of the fifth circle; which will appear plain by conſidering the dotted lines relative to Courſe VII. upon the ſurface of Courſe VI. (ſee Plate N° 10. Fig. 6.) There could conſequently be no application of wedges in the upper courſe to the faſtening of the circle of ſtones (N° 5.) upon their reſpective cubes: when therefore the ſtones reſpectively came upon them, we put as much mortar upon the top of the cube, as would in part make good the joint betwixt it and its cavity, but not enough quite to fill it; becauſe if too full there was no ready way for the ſuperfluous mortar to eſcape; but a hole, of the ſize of thoſe for the trenails, being previouſly bored through each of theſe pieces, anſwerable to the middle of each cube; when the ſtone was ſet, wedged and trenailed, then it was very practicable, by *dreſſing* a trenail ſo as to become a *Ram-rod*, to drive as much mortar down the hole as would compleatly fill every vacancy betwixt the ſtone and its cube; inſomuch that we ſoon perceived, that if this was attempted before the ſtone was compleatly trenailed down, that it would very eaſily raiſe the ſtone from its bed, as might indeed be expected from the principles of *Hydroſtatics:* but being done after ſuch completion, it brought the whole to the moſt ſolid bearing that could be wiſhed; and when the cement was *hardened* anſwered the end quite as effectually as if they had been wedged.

It may here be very properly ſaid, that ſince thoſe cubes could be of little uſe in keeping the work firmly together before the mortar was *hardened*; and after that had taken place, they could be of no uſe,

uſe; becauſe the number of 108 trenails, of which one of theſe courſes conſiſted when compleat, being ſuppoſed ſufficient to keep it from lifting and moving out of its place; as the mortar hardened, and every additional courſe was an addition of its own weight upon the former, if thoſe cubes could have been diſpenſed with in the firſt inſtance, they might have been ſo ever after.——This reaſoning I can very well admit to be true; yet, when we have to do with, and to endeavour to controul, thoſe powers of nature that are ſubject to *no calculation*, I truſt it will be deemed prudent not to omit, in ſuch a caſe, any thing that can without difficulty be applied, and that would be likely to add to the ſecurity.——It may further be remarked, that as this building was intended to be a maſs of ſtone held together by the natural and artificial union of its parts, it would have been out of character, that when compleated, it ſhould be beholden to certain parts of *Wood* for its *Conſolidation**.

229. I HAVE mentioned, § 67. that I originally conceived more than one way of preventing the courſes from ſhifting place upon one another. My firſt conceptions were to form a riſe (or a depreſſion) of three inches, bounded by a circle ſomewhat about the diameter of that in which the joggles are placed; which ſtep or depreſſion would have formed a ſocket, whereby the courſes would have been mutually engrafted, not much different from what nature has pointed out in the *baſaltine* columns of the *Giant's Cauſeway*: but conſidering how much unneceſſary trouble and intricacy would be hereby introduced, by one part of the bed of the *ſame* ſtone being liable to be three inches higher than the other, I judged that the end would be very ſufficiently anſwered by the much more plain, eaſy, and ſimple method of joggles; eſpecially as, for this purpoſe, the firmeſt and tougheſt kind of ſtone might be choſen, and the number multiplied at pleaſure. One *plug* in the middle, of a foot ſquare, and eight *joggles* of a foot cube each, of the hardeſt marble, diſpoſed in the manner deſcribed, ſeemed to me, along with the additional ſtrength and ſecurity ariſing from the trenails; as alſo from the infinite number of little indentures upon the ſurface of the courſes, as well as the Lewis Holes, each being filled with an extuberance of mortar, which, when hard, would in effect become a *ſteady pin*; from the *cohеſion* of the mortar as a ſolid, promiſing to be no leſs than that of the ſtone; together with the incumbent weight of every part of the building above; every joint thus ſeparately conſidered, ſeemed in point of firmneſs ſo ſatisfactory to my mind, that if the whole of this proved too little, it was out of my power to conceive what would be enough.

230. WHILE I am upon this part of my ſubject, I will take an opportunity of obſerving that it was a part of my problem, which I will not take upon me to ſay that I have accurately ſolved; but I have endeavoured to do it, ſo far as my *feelings*, rather than *calculations*, would bear me out: That the building ſhould be a column of *equal ſtrength*, proportionate in every part to the ſtreſs it was likely to bear, (regard being alſo had to its *uſe*,) was a view of the ſubject I was naturally and forcibly led to, as I found it eternally rung in my ears from all quarters, that *a Building of* STONE *upon the Edyſtone would certainly be overſet*. I therefore endeavoured to form it, and put it together ſo, that while a ſimilarity of uſe permitted a ſimilar conſtruction, no man ſhould be able to tell me at *what* joint it would overſet; for, if at any given height the uppermoſt courſe was, when compleated, ſafe, it became more ſafe by another courſe being laid upon it; and that upper courſe, though ſomewhat leſs in weight, and in the total cohеſion of its parts, than the former; yet every courſe, from the firſt foundation, was leſs and leſs ſubject to the heavy ſtroke of the ſea.

231. IN the morning and evening's tide of the 17th we ſet the whole of the fifth tier, and conſequently the whole of the eight cubes were then inlaid. The morning of the 18th we again landed; but Mr. WESTON, after expreſſing his entire approbation of our proceedings, returned to Plymouth in the Aſſiſtant; I ſtaid in hopes of ſeeing the whole courſe cloſed. In this morning and evening's tide, though rough, we had got ſet five pieces of Circle 6. and had landed the remaining three; as alſo one of the

* Indeed the application of theſe cubic joggles ſo well accords with my feelings in reſpect to ſtability, that I ſhould even now have regretted it if they had been omitted; and ſhould be ſorry to have them *now* removed, if it was poſſible.

largeſt

largeſt pieces of moorſtone for the eaſt ſide, (ſee Plate N° 11. Fig. 1.) This evening's tide we worked with links, and it began to blow ſo freſh that we had much ado to keep them in, being obliged to make a fire of them upon the ſurface of the work. We were under the neceſſity at laſt to quit the rock with ſome precipitation, and were very glad to get into our yawls; things being left in the following poſture. Two of the pieces, Tier 6. were ſimply dropped into their places on the north-weſt ſide, while the third piece, being about a ton, and the piece of moorſtone near upon two tons, were chained together, and to the work of Courſe VII. that was already ſet; theſe two looſe pieces being upon the top of that courſe near the eaſt ſide: the triangles were laſhed down upon the floor of the work, as we had practiſed ſeveral times before.——The ſea became ſo rough in the night, that the Weſton at the tranſport buoy was obliged to *ſlip* and make for an harbour. Next day the wind increaſed, ſo that the ſea broke over the ſhear-heads at low water. I waited in hopes of an alteration of weather till the 22d, when I returned to Plymouth in the yawl, the wind being S. W.——Upon the 25th, though the weather continued ſtill bad, the Aſſiſtant carried out RICHARDSON and company, and brought home Mr. JESSOP and company, who left every thing well upon the rock, as far as they could diſcover from the buſs, but had ſhared their laſt pound of bread. The bad weather ſtill continued to increaſe till the 28th, when there was a violent ſtorm at S. W. ſo that the *Antelope* man of war in the *Sound*, of fifty guns, dragged her anchors, and was in great danger of driving upon the rocks.

The 29th I perceived with my teleſcope, from the *Hoa*, the buſs to ride ſafe, but could not ſee the ſhears, or indeed any thing elſe upon the rock diſtinctly, except the breakers. The day following being more clear, and the ſea ſomewhat ſubſided, I diſtinctly ſaw the buſs and the rock; but the ſhears not being viſible, I immediately went on board the Edyſtone boat to reconnoitre the ſtate of things, and left orders with Mr. JESSOP in the mean time to prepare new ſhears.——The wind being N. W. I paſſed the rock ſeveral times under ſail, but there was no poſſibility of landing.——I obſerved that not only all the work which had been compleatly ſet was entire, but that the two ſtones mentioned to have been ſimply lowered into their places alſo remained therein, and that the 5 cwt. ſtill reſted upon the ſtone whereon it was left. The weſt face of the building had got ſo compleat a coat of ſea weed that it was only diſtinguiſhable from the rock by its form: but the ſhears and triangles were entirely gone; the two pieces of ſtone that had been chained together and to the work, were alſo gone; the windlaſs frame broken and much damaged, and the roll gone; the fender piles and the tranſport buoy however remained in their places.——The buſs I was told had rode it out very well, but not without frequently alarming the company on board, with an apprehenſion of her breaking looſe, ſhe having ſhipped many heavy ſeas on deck, and one ſo great they expected the deck to have been ſtaved in; they had veered out ſeven fathoms of bridle cable, but were afraid to eaſe out more, leſt it ſhould touch the rocks.——This was in reality the greateſt ſtorm we had ever experienced while out at the rock; yet we were leſs chagrined for the damages done, than thankful that they were not greater.

232. THE 1ſt of September JESSOP and company went out to ſhift RICHARDSON; who ſent me a letter, informing me they had caught an opportunity of reconnoitring the Gut, and found the two ſtones waſhed off from the rock to be lying therein, and which, as he apprehended they could be weighed, there would be no need to proceed with new pieces on ſhore. It was the 3d of September before this company could make a landing to do any thing upon the rock; ſo that ſince the 18th ult. there had been an interval of fifteen days in which we had been totally interrupted by bad weather in the very prime part of the ſeaſon. However, every thing having been expedited on ſhore to get refitted for work, this day I went out therewith, and began to ſet up our new ſhears, windlaſs, &c. and with the ſhears got up the piece of Portland of Circle 6. which was ſet, as alſo the others that had been left looſe in their dovetails; but the tide of flood coming on, had deepened the water too much before we could try to get up the other.

The getting up of the piece of Portland ſtone was effected by means of the ſame utenſil wherewith we got up that mentioned § 212; and though it lay the wrong ſide upward, yet as the trenail holes always reached through the ſtone, into which the inſtrument was introduced, (ſee its deſcription,) this difference of circumſtance was at preſent of no conſequence; but when the next day we introduced it into one of the

trenail holes of the piece of moorſtone, that lying alſo the wrong ſide upwards, (for the holes being bored from the upper ſide, were therefore naturally a little taper), this circumſtance prevented the pin from going in ſo far as it otherwiſe would have done; the holes being alſo nearer the corner, and the ſtone double the weight of the former, when the ſtone was got up to the ſurface of the water, it then becoming heavier by loſing its buoyancy, the pin became bent, and thereby the hold of the tool upon the ſtone releaſing, it dropped down again to the bottom; it however fortunately fell upon its end, and in this poſition we found means to get a chain round its waiſt.——To one of the ſtrong chains, which were about ten feet long, wherewith we uſed to chain our looſe pieces of ſtone upon the work when we left them, we faſtened a rope to each end, and lowering the chain in a loop beyond it, we could then, by bringing the two ropes together, bring the chain round the waiſt of the ſtone; but the difficulty was to confine the two parts together ſo cloſe to the ſtone, as to prevent its turning out of the chain when we came to heave upon it: for this purpoſe I bethought me of putting an iron ring over the double rope, the weight of which might draw the two parts together; but that not proving to do it ſufficiently, while expedients were concerting, JOHN BOWDEN, whoſe invention was ever ready, cried out, "*Twiſt the ropes*, maſter;" and by this ſimple expedient, the parts being drawn ſo cloſe that the ring went home, it was impoſſible for the ſtone to ſlip, and therefore, not long before it was relanded upon the rock*.——The depth of the water was twelve feet.——The three parts of the *Lewis* by which this ſtone had been chained, were found in the hole, but the bolt and ſhackle were gone. The like parts of the lewis were left in the work to which the ſame chain was hooked, but the bolt was gone, and half of the ſhackle found in one of the cube holes. We alſo remarked that the ſurface of the work upon which the ſtones had lain, that had been chained, was brought almoſt to a poliſh, as well as the under bed of the Portland piece that was driven into the Gut. ——As the ſhears were faſtened at the top as well as the bottom, it is difficult to ſuppoſe they could at once leave the rock; moſt probably therefore it was the legs of the ſhears that broke the windlaſs after one or both had got looſe at bottom; otherwiſe it is not eaſy to imagine that the water could lay ſuch hold of its frame as to break it in the manner it was broken, being wholly of iron. (See Plate N° 14. Fig. 1.)

233. SEPTEMBER the 5th the ſeventh circle was finiſhed and the eighth begun; and this day the wind being variable from N. E. to N. W. and very moderate, was remarkable, as being the firſt time of the people having worked, till they were obliged to quit the rock for refreſhment: and now every thing being reinſtated, it was ſome time before we met with any but the ordinary interruptions.——On the 7th I had notice from Mr. JESSOP of his expecting to compleat Courſe VII. that day, being the firſt circular courſe: I therefore went, accompanied by Meſſrs. WESTON and RICHARDSON, on board the Edyſtone boat, which was loaded with the center, and its ſurrounding ſtones, of Courſe VIII. We arrived at the buſs in the night, and were informed by Mr. JESSOP, that the weather had been ſo calm that the top of the work had not been wet for three days; that therefore they had worked from light in the morning to dark in the evening, but not in the nights. That Courſe VII. was compleatly cloſed, pointed and grouted; and that the top of the work, where it needed, had been levelled, and every irregularity in the face of the work rectified.——In the morning of September the 8th, we landed at break of day, and the Edyſtone boat having been unloaded, we proceeded to ſet her cargo: and, beſides the ſatisfaction that Mr. WESTON enjoyed in ſetting the center plug of Courſe VIII. which was managed in all reſpects as already deſcribed of Courſe VII.† he was entertained with the appearance of a fleet around us, conſiſting of a convoy of

* On this occaſion it may not be amiſs to obſerve the great advantage that ariſes, in the greater operations of mechanics, from the having commodious tackles and utenſils. We had not compleated the ſetting up of the windlaſs, when we found it neceſſary to heave up the two ſtones before mentioned; we therefore (applying a ſufficient number of men to the main tackle) heaved them up *by hand*: and though there was no *difficulty* in this, yet I could not help remarking the vaſt difference there was in the *Time* and *Power*, between the application of men's ſtrength in this way and by the windlaſs. I therefore afterwards purpoſely noted the minutes they were in heaving up one of the large moorſtone pieces of Circle 7. by hand from the boat; and by the time this was done the windlaſs was compleated; and then, by a ſimilar trial therewith, found that four men at the windlaſs hoiſted a ſtone in *half* the time that it took twelve men to do in *heaving by hand*, though the *Tackle* remained the ſame to both.

† It may be neceſſary to ſay, that this center plug was four inches ſhorter than the *firſt*; becauſe Courſe VI. being thirteen inches thick, was four inches more than half the *medium* thickneſs, of the courſes above, which were eighteen inches at an average.

above

above a hundred ſail of *Weſt India* and *Mediterranean* merchant ſhips; to whoſe future ſafety, we had the ſatisfaction to ſuppoſe ourſelves contributing.——After ſetting the plug and the center ſtone, Mr. WESTON returned to Plymouth.

The fineneſs of the ſeaſon now continued to favour the expediting of our works, inſomuch that Courſe VIII. which was begun upon the 8th, was executed in five days, being entirely compleated on the 13th at the ſame hour. Every thing went regularly on till the 20th; ſo that in return for our continued interruption from the ſtormy weather for fifteen days, our works had an uninterrupted progreſſion for eighteen days, when Courſe IX. was advanced to the fifth circle: but at this time, notwithſtanding the wind had been moderate at E. for a week paſt, yet there came on ſo great a ground ſwell from the ſouth-weſt, that though both the companies had uſed their joint endeavours to get the Edyſtone boat into the Gut, they had not been able to effect it.

234. THE greateſt hinderance we had met with during the laſt fine ſeaſon aroſe from the uncommon *lowneſs* of the tides, which were ſo much ſo, that our ſtone veſſels were liable to be catched by the keel in going out from the Jetty Head in Mill Bay. This inconvenience was in a great meaſure remedied by a thought of Mr. JESSOP's, who contrived to borrow a *Punt* or flat ſquare veſſel, which, being loaded at the Jetty Head, was then hauled out into deep water, where her cargo could be ſhifted into the boats of paſſage, at any time of the tide.——An incident however happened, reſpecting our uſe of this punt, that demonſtrates the extreme degree of malevolence which *ſometimes* poſſeſſes the breaſt of man. She was loaded on Monday the 12th in the evening, and hauled out as uſual; and the next morning (the night having proved uncommonly calm) the punt was found, on hauling up her moorings, to be ſwinging by a ſingle yarn, the reſt having been cut with a *knife*, at three fathoms under water; doubtleſs that it might not be diſcovered, otherwiſe than by the effect of the veſſel's being driven upon the rocks, and there ſunk with her cargo, to our no ſmall diſappointment in the progreſs of the work: a circumſtance, that as it could not contribute to any man's advantage or pleaſure, indicated a degree of *turpitude*, at which, were it not for ſuch inſtances as theſe, it could hardly be ſuppoſed the human mind was capable of arriving.

235. IT was not till the 25th that any of the boats could keep the ſea; for when they attempted to go out, they were as often obliged to return with their cargoes: however, the Weſton's cargo being firſt wanted; J. BOWDEN, always deſirous to promote the ſervice to the utmoſt of his power, went out this day to the tranſport buoy, with a reſolution to ride it out there if poſſible, and which, with great difficulty and ſome hazard, he did; and in the evening of the 26th his cargo was landed, which enabled the work to go on again as intervals offered. I went out on the 27th, and was witneſs to the great difficulty there was in preſerving the boats from being wrecked in the gut; the eaſterly wind having raiſed ſo great a ſwell on that ſide of the rocks, that two of them ſucceſſively broke their faſtenings, and were in the utmoſt peril of being ſtaved; yet ſteadily endeavouring to uſe our *beſt efforts* to expedite the work, no material damage in reality happened; though the boats rolled to that degree, that every moment one would have expected the maſt of the veſſel and the ſhears to have got entangled together ſo as to carry one or both away.

236. THE 29th of September all the remaining pieces belonging to Courſe IX. were happily landed from the Weſton, and the veſſel got clear of the Gut.——We found the beſt method of a boat's going into the Gut was; when ſhe arrived at the tranſport buoy, for one of the yawls to carry her a rope to the landing-place, as alſo one to the principal rocks on each ſide, entering the Gut; thoſe on board then heaving upon whichever of theſe three ſeemed moſt requiſite, alſo veering out a ſufficient rope *double* from her bows, and paſſing through the ring of the tranſport buoy, ſhe goes into the Gut *ſtern foremoſt*; and by theſe means has a faſtening head and ſtern, as alſo one on each ſide.——When going out of the Gut, ſhe heaves by the double rope towards the tranſport buoy, and when clear of the rocks ſhe can either go to the buoy, or, by the rope's being double, ſhe can ſlip her hold of it, and get under ſail. ——A ground ſwell coming from S. W. ſoon after, obliged us to quit the rock; but the next day we landed, and ſet the remaining ſtones, which compleated Courſe IX; and the maſons proceeded to rectify the face

face of the work, where it was in any degree wanting thereof, that there might be no need hereafter to diſturb any part of the coat of weed, which was likely to fix upon it during the winter.

237. BEING now arrived at the eve of October, I maturely conſidered our ſituation; and finding that we had been eighteen days in compleating the laſt courſe, whereas the former one (Courſe VIII.) was begun and finiſhed in five; though the weather, both on ſhore and above-head, had remained to all appearance much the ſame; I from thence concluded it to be very probable, we might not get another courſe compleated in the compaſs of the month of October; ſo that when I reflected on the many diſaſters we had ſuffered laſt year, by continuing out till the month of November, and how little work we in reality did after *this* time, it appeared to me very problematical whether we might be able, with every poſſible exertion, to get another courſe finiſhed this *Seaſon:* and conſidering how very ineligible it was to have a courſe lie open during the winter, in this ſtage of the work; and that we had now got three compleat courſes eſtabliſhed above the top of the rock, the ſum of whoſe heights was four feet ſix inches; and that we could not leave the work in a more defenſible ſtate, whether as relative to the natural violence of the ſea, or the poſſibility of *external* injuries; from theſe conſiderations, it appeared to me highly proper to put a period to the out-work of the preſent ſeaſon; and this opinion was heartily concurred in by Meſſrs. JESSOP and RICHARDSON.

We therefore proceeded to take down the ſhears and windlaſs, and to weigh the tranſport buoy chain and anchor, which we ſucceſsfully did, by applying all hands thereto on board the Weſton; but in effecting this we providentially eſcaped what, if it had taken place, would have proved in all probability a very unfortunate diſaſter.——The anchor, as mentioned § 208. being of 12 cwt. was a heavy one in proportion to the ſize of our *Craft*; and it was weighed by means of its buoy rope, and got cloſe to the bows of the Weſton. The chain of the tranſport buoy then hung down in a loop from the ring of the anchor, the other end being ſupported by that buoy; which, that the whole might float together, was confined to the ſide of the Weſton by a ſmall *luff*-tackle which laid hold of it.——We then proceeded to hoiſt the tranſport buoy into the Weſton by her runner and tackle, from the maſt-head; but the hook being too ſmall to encompaſs the ring of the buoy; it was fixed by means of a ſalvagee: and this ſmall circumſtance ſaved us; for by the time the buoy was hoiſted out of the water, obſerving that its weight and appendant chain a good deal *heeled* the Weſton, and was in conſequence making a ſtrong effort to quit the veſſel's ſide, I ordered the tinners to *hold faſt* the *luff-tackle*, which they unfortunately miſtook for an order to *let go* the luff-tackle; on this the buoy immediately quitted the veſſel's ſide: I happened to be with others in the yawl on the outſide of the buoy, where we had been faſtening the ſalvagee; and ſeeing the buoy ſeparating from the veſſel, and driving us outward, and that the weight of the buoy and chain was gaining more and more purchaſe upon the maſt, as it heeled more outward; in conſequence, there being nothing to prevent the further ſeparation of the veſſel and the buoy, this advantage muſt have become every moment greater, till the veſſel had overſet, filled, and ſunk: in this dilemma it occurred to me to make uſe of my *Pocket Knife* to cut the ſalvagee; which being inſtantly done, the Weſton immediately righted, and the buoy was ſoon after got on board in the manner it was firſt intended.

238. THE 1ſt of October we proceeded to heave in the bridle cable of the buſs, and inſtead of it to fix to the great ſwivel of the moorings (which we found unhurt) a new buoy chain that we had received from London, to be applied inſtead of the other; which being made with ſhort links, would relieve us in future from the anxiety we had in heaving up the bridle chain and ſwivel the beginning of this ſeaſon. (See § 207.) This was put down, and the great buoy and chain affixed upon the top of it, which had rode the whole of laſt winter, and had ſerved us as a tranſport buoy during the ſeaſon we were then about concluding. The buſs was now rode by this buoy till the wind ſhould come fair to carry her into harbour; the whole being ready to caſt off at a moment's warning.——This buſineſs being compleated, and a good opportunity of landing on the rock offering itſelf, I again went upon it with Mr. JESSOP and the maſons; and having compleatly rectified the outſide, and finiſhed every thing to my mind, we went on board the Weſton and Aſſiſtant with the company, leaving the buſs to the care of the ſeamen, who were

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all on board, except the two maſters of the boats, BOWDEN and MEDLING, in their reſpective veſſels, and landed at Plymouth the ſame evening.——The next day, Sunday October the 2d, BOWDEN and MEDLING went out to aſſiſt SMART and the other ſeamen in bringing in the buſs as ſoon as the wind came fair.——They ſailed with the buſs on Monday the 3d at four P. M. but it was not till the next day at noon that ſhe arrived at Mill Bay: ſhe was hauled up upon the beach the ſame evening, and I took leave of the work-yard for that ſeaſon; exhorting the men to diligence and unanimity, and leaving every thing about the work up to the entry door ready to go to ſea, which was intended to be pitched upon the fourteenth courſe, I ſet forward from Plymouth for London the 5th of October*.

* Beſides what precedes, in relation of the incidents of the laſt ſeaſon, I have omitted one in its proper place, that may indeed be eſteemed more of a ludicrous than a ſerious nature; and, as it was not ſet down in my Journal at the time, depends now altogether upon my memory; as however the thought might, in like caſe, have its utility, I will give it a place in this note.——I think it was after we had got the ſhears refitted, after the ſtorm § 232. I was deſirous to ſhew the people the advantage that might be had from the conſtruction of the ſhears, in enabling us to get off from the rock, in caſe any of us ſhould be left there, when the yawls could not poſſibly go alongſide to take us off in the uſual way: and, to introduce the affair the more readily, I ſet about to give them an example. From Plate N° 14. it will appear that the ſhears were kept upright, and were managed, by two ſtrong guy (or guide) ropes, one paſſing from the head of the ſhears over the area of the houſe, which was faſtened to the rocks, above low water, on the weſt ſide of the rock; the other, counteracting it, paſſed over the Gut, and was fixed to one of the rocks in the ſouth reef on the *eaſt ſide* of the Gut. This laſt rope therefore wholly croſſed the Gut, obliquely from the top of the ſhears, down nearly to low water mark. I mounted to the head of the ſhears, and clung upon the guy rope, and, as the deſcent was with a conſiderable declivity, it was eaſy to work myſelf downwards, which I did without difficulty, till I approached ſomewhat near the ſurface of the water; I then ordered the yawl to come underneath me, to take me in, and when I found my feet in the boat, I concluded I had nothing to do but quit hold with my hands; but the very moment in which I quitted hold, the boat took a ſudden *yaw* or *ſheer*, which canted me overboard, head-long into the ſea. No ill conſequence however happened, except a thorough wetting to myſelf; but failing of ultimate ſucceſs, though by means of a *collateral* circumſtance not neceſſarily connected with the operation, no one ever repeated the trial; that is to ſay, we were never put to the real *want* of it; though every one preſent was convinced of the practicability of the *manœuvre*, in caſe neceſſity ſhould in future call for it.

CHAP. II.

Comprehending the Account of Tranſactions from my leaving Plymouth in October, 1757, *to the Concluſion of the Working Seaſon of* 1758.

239. THE interval between the concluſion of the outwork of the year 1757, and the commencement of that in 1758, furniſhed ſome memorable events.——The firſt that happened was of an untoward nature. In the beginning of December there happened a violent ſtorm, ſo great as to drive the floating light from her moorings, and oblige her to go into Plymouth; and from whoſe maſter we learnt, that in paſſing by the Edyſtone all then appeared to be well. From this time the weather continued ſo tempeſtuous that it was the month of March before any of our boats could venture out to reconnoitre, when I received a letter from Mr. JESSOP, containing the diſagreeable news, that the great buoy of the moorings was gone, as alſo the buoys of the anchors; but that the ſeamen were at work *ſweeping* for the anchors, and though they had not been ſo lucky as to find them, yet when the weather became more favourable, they did not doubt of ſucceſs.——This was a matter that required the fulleſt attention; and, on a conſultation with the proprietors, it was determined not to reſt the matter ſolely upon the efforts of our ſeamen, but, to ſpur the whole body of fiſhermen, &c. upon the coaſt to exertion, a reward of £. 50 was offered to whoever ſhould recover the moorings. At the ſame time it was further determined not entirely to truſt to our hopes of finding them, and therefore, without loſs of time, a new ſet of chains was beſpoke of Mr. WILSON of *Blackwall*, who had made thoſe already deſcribed; ſo that theſe might be going on while endeavours were uſed to find the former; and if found, there would be no other loſs, than that we ſhould have ſo

much ſpare chain upon hand as ſhould be made at the time; and which, as what *had happened* might happen again, there poſſibly would be occaſion for in future. This matter being therefore now in a proper train, I ſhall proceed to an event of a more pleaſing kind.

240. THE proprietors of the Edyſtone acquainted the Corporation of TRINITY HOUSE that their engineer being now in town, and, having made a conſiderable progreſs with the work upon the rock, was, together with themſelves, deſirous of giving them full information of the proceedings; and that nothing would be more ſatisfactory to the public, as well as to themſelves, than to merit their approbation. This was the 21ſt of March, and on the 22d they received an anſwer from Mr. SHUTTLEWOOD, Secretary to the Corporation, appointing the Saturday ſe'nnight following.

In this interview I had the pleaſing ſatisfaction of fully explaining to that honourable Board, not only what I had done, by means of the models and drawings I had laid before the Board of Admiralty, but alſo what I propoſed further to do; obſerving, that what was already executed would *equally ſerve* as a very firm foundation and baſement for a *Timber* ſtructure, in caſe it ſhould be their opinion that ſuch a one would be preferable to that of ſtone propoſed: but, after a full inveſtigation, they were pleaſed to honour the propoſition with their decided opinion, that nothing could anſwer ſo well as the building propoſed; which opinion was ſtill the more acceptable, as it was that of the *moſt competent* judges.

The Board, after many enquiries concerning the place and manner of our moorings, were pleaſed to offer me a ſet of mooring chains, they had at Falmouth, in caſe we ſhould need them, which though neither new nor ſo heavy as thoſe prepared, by their directions, for the Neptune buſs, yet might ſerve on occaſion, as we did not expect to continue out in the *worſt* of the ſeaſon. The corporation were alſo pleaſed to deſire me to give them at times an account of my proceedings and progreſs, from Plymouth; by their doing which, I eſteemed myſelf much honoured, as well as obliged by the offer of the chains.

241. AFTER this the accounts from Plymouth continuing conſtantly the ſame; that every thing was going on briſkly in the yard; that the ſeaſon was but little favourable to the ſweeping for the recovery of the moorings; and that the attempts which had already been made, proved abortive; I took a reſolution of going down to Plymouth, though not by way of proceeding with the building, till the ſeaſon arrived when the weather was more likely to continue ſettled, as well as fine; yet, as I had frequently found difficulties to be ſurmounted when I was preſent, that continued obſtacles when I was abſent; and though the operation of *ſweeping** was not a thing to which I had been accuſtomed, I notwithſtanding found myſelf much inclined to be preſent, in order to expedite the buſineſs as far as in my power.

242. I ARRIVED at Plymouth on Sunday the 16th of April, and found every thing at Mill Bay to my ſatisfaction; the laſt cargo of ſtone from Portland having been delivered in December, and Courſe XXXI. was in hand working, being that whereon the windows of the ſecond room were to be placed. The ſolid part of the houſe was entirely compleated and off the platform, ſo that had our moorings been in readineſs, I might have been tempted to have carried out the buſs.——But I was ſcarcely arrived at Plymouth before an expreſs came after me, upon a difficulty that had ariſen in the progreſs of the *Calder Navigation* Bill, and I was wanted to attend a committee of the *Houſe* of *Commons* upon the 24th inſtant: I therefore was obliged to content myſelf with a conſultation with our ſeamen and Mr. JESSOP; and it was their opinion, that as, from the roughneſs of the rocks at the bottom, the anchors would natu-

* The operation of *ſweeping* for an anchor is as follows. A couple of boats of a proper ſize are manned; and, as near as they can judge of the place where the anchor lies, they, at a competent diſtance from each other, row or ſail abreaſt, having a hawſer or ſmall cable paſſing from one boat to the other, and of ſuch a length that a conſiderable part of it may drag upon the ground. This, on a plain bottom, will naturally hang upon the arm of the anchor ſtanding obliquely upward, provided the ſhank of the anchor lies eaſtward, that the tide runs weſt at the time of taking the ſweep, and the boats are moving *with* the tide; for it is evident, if the hawſer hooks upon the anchor, that the two boats will tend to come together; and, the two parts being brought into one boat, if ſhe heaves upon them till ſhe approaches nearly over the anchor, as the cable will be prevented by the broad part or *Fluke* from ſlipping off the arm, a proper purchaſe being then applied, the anchor may be weighed.

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rally get into the hollow places, the ſweep ropes had conſtantly gone over without touching them; and therefore they adviſed to ſweep with a ſmall rope, not ſufficient to weigh the anchor; but firſt to hook it, and then to ſweep with a larger rope with weights upon it, ſo as to ſink it into the hollows, and thereby catch the anchor alſo.

243. IN this ſituation I left our ſeamen to make the trial, the promiſed reward not having as yet excited any others to the attempt. I attended upon the 24th at the Houſe of Commons, and upon the 30th was back again at Plymouth; when, on my arrival I was told by the ſeamen, that by the ſcheme concerted before I left them, they had the preceding day the good fortune to hook one of the anchors, which they weighed off the ground; but were unable to bring it to the ſurface, on account of the heavineſs of the chain to which it was fixed, and the ſmallneſs of our veſſels; however, they had ſecured the ſweep rope by letting drop a *Runner-Ring*, as mentioned § 232, and had fixed a buoy thereon.——It happened that the tides ran ſo remarkably ſhort at this time, that our buſs did not float at high water. We therefore procured the uſe of a ſloop that lay in the harbour, which the very next day was fitted out with a roll proper for heaving up the anchor and chains; and, at three in the morning the 2d of May, I went on board with Mr. Jessop, all our ſeamen, and eight or nine hands from our yard; the *Aſſiſtant* accompanying us. We arrived at the moorings at eight; at firſt we could not ſee any thing of the buoy the ſeamen had fixed, but when the tide was fallen away we got ſight of it, and ſoon weighed the mooring anchor; but by the time we had got it above water the wind began to freſhen at eaſt, and raiſed ſuch a ſwell that we durſt not attempt to get it upon deck, ſo as to haul in the chain and come at the bridle; and therefore were obliged to be contented with ſecuring our temporary buoy rope upon the anchor, lowering it down again to the bottom, and then return to Plymouth.

The weather remained unfavourable till the 11th of May, when we went out with the buſs; and, having conſidered the numberleſs diſappointments which we had experienced, chiefly as it ſhould ſeem, from the ſtiffneſs of the ropes and unevenneſs of the bottom, I had determined to get a ſix inch cable *laid* of a ſufficient length for ſuch purpoſes, and the yarns to be ſo looſely twiſted together that it might be conſidered as of the nature of a *Salvagee*: carrying this along with us, and finding the place of the anchor by means of the buoy we had fixed upon it, we laid effectual hold of the anchor with it, which was in twenty fathoms water, and ſoon got it up to the bows; but when we began to heave in our ground chain, we found it to come in much heavier than we expected. We thereupon fixed our great tackle to it in addition, and hove all *taught*, but without procuring any more of the chain. We therefore made all faſt, and, it being nine P. M. concluded to let all ſtand till the next morning. The wind then beginning to freſhen at E. the buſs got ſome motion, and while we were refreſhing ourſelves there came on a ſudden rumbling of the chains, which put the buſs into ſo great a tremor, that we concluded the chains were gone overboard to the bottom; we ran upon deck, and, to our great ſurprize, found all ſtanding as we left it: after this two or three more rumblings enſued, but gradually leſs; ſo that it would ſeem the chains had by degrees diſentangled themſelves from the rocks, as after this the buſs rode without any particular ſtrain upon the tackle; and the wind continuing freſh, we did not reſume our work till day-break on the 12th.——The ground chain now came in kindly, and about ten o'clock we came to and got in the bridle and ſwivel, the buoy chain being faſt thereto; as alſo the under buoy and the upper chain; which, as it appeared to me, had ſunk the under buoy to the bottom, it being much water ſoaken. In fact, we recovered the whole of our moorings, except the upper or great buoy, and the bolt by which it had been fixed; ſo that from the appearance we concluded the failure had been in the *Forelock** of the bolt; but whether it had gradually worked itſelf looſe by the continual motion, or by ſome violent jerk of the ſea, or blow from ſome veſſel's having run upon it, we could not determine.——By three o'clock we got the chains and the anchor lowered, and the buſs as compleatly moored, in our own opinion, as ſhe ever had been in either of the former ſeaſons; which, conſidering the number of diſappointments we had experienced, muſt be ſuppoſed to have been attended with unuſual joy and ſatisfaction.

* A *Forelock*, in ſhipwrights terms, is the key or wedge by which a bolt is drawn tight, or prevented from ſlipping out.

244. DURING the time I was out upon this buſineſs, I took an opportunity at pinch of low water to view the works upon the rock. It was with no ſmall difficulty that I landed; but I was much ſurprized, notwithſtanding what had been reported of the ſoundneſs of the work, to find it ſo perfectly entire; for, except a ſmall ſpawl which had been waſhed from the rock itſelf, the whole did not ſeem to have ſuffered a diminution of ſo much as a grain of ſand ſince I left it on the 1ſt of October: on the contrary, the cement, and even the grouted part, appeared to be as hard as the Portland ſtone itſelf; the whole having become one *ſolid maſs*; and indeed it had that appearance, as it was then entirely covered with the ſame coat of ſea-weed as the rock, the top of the work excepted, which was waſhed ſo clean and white, that the lines thereon appeared more diſtinct than they had done upon the platform in the work-yard; no weed having fixed upon the upper ſurface except in the cube-holes and lewis-holes, which conſtantly holding water, were grown over with green weed like the outſide. The ſender piles were indeed all gone, but this was a trifling diſaſter, as they could ſoon be renewed; and we thought ourſelves happy in the proſpect of getting to work upon the rock ſo early in the ſeaſon.

245. SATURDAY the 14th of May the whole of the Portland ſtone work being compleated in the work-yard, the ſtone-cutters in that branch were diſmiſſed: and upon the 16th the ſender piles at the rock were reſtored; contenting ourſelves now with two, fixed as is ſhewn in Plate N° 14. The ſhears, the windlaſs, and all the rock tackle, with the tranſport buoy, being compleatly fixed*, our boats were now loaded with ſtone, and the firſt ſailed to the tranſport buoy; but though the weather was not favourable for delivering their cargoes, yet it being ſeaſonable, I determined they ſhould keep out from Mill Bay, that they might take the earlieſt opportunity, and no time be loſt. And now, what could hinder our progreſs? Yet ſuch however is the uncertainty of human affairs, and particularly of thoſe that depend upon the ſtate of the winds and waves, that, from this time till the 2d of July, inſtead of proſecuting the work, our thoughts and attention were wholly employed to remedy diſaſters.

246. HAVING employed the 16th of May in writing an account of our late proceedings to the TRINITY BOARD, I went out to the buſs to take the firſt opportunity of landing the center ſtone of Courſe X. the veſſel that had it on board riding at the tranſport buoy; thus every thing continued fair and promiſing, and we expected every hour that the ground ſwell would ſubſide ſufficiently to give us leave to get the veſſel into the Gut. In this ſtate we were obliged to wait from day to day till the 23d, when, about three o'clock in the morning, the watch upon deck came down to acquaint me that the buſs had dragged her eaſtern anchor, for that ſhe had got a conſiderable diſtance from the buoy; whereupon we all haſtened upon deck, and found that we had really got out of the accuſtomed place; however in a little time the buſs came apparently into her former ſituation, and finding the bridle *taught*, we concluded ſhe had taken ſome extraordinary ſwing, and that all was come right again. After waiting awhile for the approach of day, we could not diſcern our buoy, and we obſerved that we were removed further from the rock, ſo that, on applying to the bridle a ſecond time, we found that the chain was dragging upon the rocks: but how it had been ſeparated, as the buſs had not rode with any extraordinary ſtrain ſince ſhe was laſt placed at her moorings, we could by no means gueſs; and finding that we ſtill continued driving from the rock, we concluded to drop an anchor as ſoon as we got into clean ground. The ſpring-tide of flood however came on ſo ſtrong, that though the wind blew a freſh gale at E. we were carried ſo faſt to the caſtward that we concluded it unſafe to anchor, and therefore adviſable, for the preſent, to *bend* our ſails (which had indeed been all unbent and ſtowed down in the *hold* for the ſummer) and try to gain *Plymouth Sound*; which being done with as much dexterity and readineſs as could be expected from three ſeamen, aſſiſted by maſons and tinners, we got under way, and proceeded to heave in our bridle cable, at the end of which was the great ſwivel with the five fathoms of chain that had been added at the end of the laſt ſeaſon, but no-

* During this interval upon the rock the maſons were employed in reducing the whole area of the work to a ſtrict level; and it was very agreeable to obſerve, that the *ſtrokes* of the mallet and tool were equally compleat and perfect in *driving a fair chiſſel draft* acroſs the joints, as upon the entire ſtone; which was a proof of the firm coherence of the component matter.

thing

thing farther; and finding that even the ſwivel had ſtruck againſt the rocks, we concluded that the bolt and ſhackle, joining this chain to the former, by ſome accidental ſtroke had got its forelock broken or beat out*, and then, by the continual working of the ſea, it could not be long before the ſhackle became unbolted, and in conſequence the veſſel ſet adrift: but having carefully placed a buoy upon our weſtern anchor, we were not apprehenſive of any other ill conſequence from this accident than the hindrance which the repetition of the ſame operation that was performed upon the 11th and 12th inſtant muſt neceſſarily occaſion.——At ten o'clock on the 23d we came to an anchor in the Sound; from whence the winds and ſeas prevented our ſtirring for ſeveral days.

247. THE 3d of June, at two A. M. I went with Mr. JESSOP and company on board the buſs, and go out near the rocks at nine; but how great was our ſurprize and mortification to find that the buoy, which we had taken great precaution to ſecure upon the anchor, was gone. We therefore came to an anchor about a mile to the N. W. of the rock, which we judged to be in clean ground, and I went in a yawl with Mr. JESSOP to make enquiries at the floating light.——The maſter informed us, that on Wedneſday the 24th ult. he went on ſhore in his boat; but it being then thick weather, it was thought adviſable to make the rock in their way to Plymouth, that they might more readily hit the Sound; and he then obſerved the buoy floating, and that two *Polparra* fiſhing boats were in ſight.

On our return to our ſtation about twelve we began to ſweep for our moorings as before, but without ſucceſs; this we repeated at ſix, when the tide became again favourable; next morning we tried again, and laid hold of ſomething which we judged to be the under buoy of the weſtern anchor; but the tide running too ſtrongly, prevented us from uſing our ſalvagee rope: we therefore went upon the rock, where we fixed the chains and rings for ſteadying the boats in the Gut; and after clearing away the weeds from the cube holes, we ſet the center plug ready for fixing the center ſtone of Courſe X; which done, we returned to our ſweeping work, not doubting but that we ſhould be able to hook the under buoy with the ſalvagee rope, and we accordingly conſtantly met with it; but the weather being untoward, the ſhort ſea raiſed thereby occaſioned ſo great a motion of the yawls, as to cauſe the ſweep rope to diſengage itſelf from its hold: and ſoon after there came on ſo great a ſea as to prevent all further trial at preſent, and made it prudent for us to weigh the buſs's anchor; ſo that in the evening we arrived with her in Mill Bay, through a rough ſea, freſh wind, thick fog, and rain.

248. WHAT we had been told by the maſter of the floating light could not fail to give us ſome ſuſpicion of the *Polparra Fiſhermen*, as having cut away the buoy for the ſake of the *cork*; a jealouſy I ſhould not have given way to, if I had not recollected the cutting the moorings of the punt the laſt year, and ſeveral other inſtances of villainy of like nature, which in ſuch caſes it would be always worth while to endeavour to detect and puniſh. With this view I accepted the offer of a friend in the Cuſtom Houſe, that I could depend upon, to go to Polparra; and, under colour of ſearching for run liquors, to try to diſcover the buoy; which was accordingly done, though without further ſucceſs than a confirmation of our *ſuſpicions*: for they learnt that three boats had been out the very day the maſter of the floating light ſaw the buoy in his way to Plymouth, and that they had brought home a large parcel of fiſh of a kind peculiar to theſe rocks; ſo that they might eaſily have diſengaged the layers of cork compoſing the buoy, and cut them to pieces for their *Crab-pots* and *Seines*, while at ſea, to prevent diſcovery.

249. FROM this time we were always prepared to go out in ſearch of our moorings, and frequently attempted it, but were obliged as often to return. On Friday the 23d, the Weſton and Aſſiſtant having unloaded their cargoes of ſtone, our men went out with a declaration that they would not return till they had found the moorings. They did not come back in ſome days; and, as I was not able to ſee any of the boats with my teleſcope from the *Hoa*, the Cawſand fiſhermen alſo reporting that they had not

* As this bolt and ſhackle would neceſſarily be in review on getting in the bridle, as mentioned § 243. the cauſe of this derangement muſt have happened after that.

ſeen them at ſea, and it had blown very freſh all the time, we began to be uneaſy for them; imagining they had ſhared the ſame fate as a fiſhing boat, which about three weeks before had been picked up by the *French* for the ſake of intelligence: but upon the 28th of June in the evening they returned to Plymouth, having, by diſtreſs of weather during the interval they were out, been obliged to take refuge in *Yealm* harbour, where they lay two days and nights, and afterwards returned to ſweep for the moorings; in which trials they ſtill laid hold of ſomething with their ſweep rope, but never had the good luck to lay hold of it with the ſalvagee rope; however they continued their trials till wind and weather drove them in.

250. DURING this time we received a parcel of chain from the ſmith in London; for, as he had continued very diligently at work upon the new chains, that were ordered upon the firſt diſcovery of the loſs of our buoy, and had proceeded with them till we had got (as we thought) compleatly moored upon the 13th of May; the quantity of chain then made, amounting to forty fathoms, was, by way of *precaution*, immediately put on board a veſſel that was about to ſail for Plymouth, and was now fortunately in our poſſeſſion. We had moreover received the Corporation's chain from *Falmouth*, amounting to twenty-ſeven fathoms, and had ready two mooring anchors, which had been purchaſed when the new chain was beſpoke.——In this ſtate of things, as the ſeaſon was approaching that we might expect ſuitable opportunities upon the rock, and loſs of *time* being the greateſt loſs that could happen to us; on a conſultation, we judged it proper to ſpend no more now, in ſweeping for the moorings, but to carry out the buſs and moor her in the beſt manner we could with the chains we had; becauſe this would not prevent a proper endeavour to recover the moorings, when time and ſeaſon was leſs precious: and though the Corporation's chain of twenty-ſeven fathoms was not above half the weight of an equal length of our own, yet we judged it might be very ſufficient for our *Eaſtern* anchor; and the new chain was of ſufficient length to allow thirty-five fathoms for the weſtern anchor, and five fathoms to turn up for a bridle; which, together with the five fathoms of bridle, and the ſwivel, which we had left, would be very ſufficient for our purpoſes. Our ſeamen therefore were ordered to go out the next day, if the weather ſuited, to make *one* more trial at *dead of neap*, when the tides run leſs rapid; and if unſucceſsful, to return in the evening to aſſiſt in carrying out the buſs: this indeed once more proved to be the caſe; ſo that every thing being ready, we went on board her the 1ſt of July in the evening, and weighed. The wind being then at north, was very fair for carrying us out; but before we cleared the Sound it began to freſhen to a ſtiff gale, it therefore became neceſſary to conſider, as our veſſel would not turn to windward, how we were to get back, in caſe we ſhould by any accident be prevented from mooring. We therefore came to an anchor in *Cawſand Bay*; and as in the evening it became very moderate, though from the ſame quarter, we weighed and made eaſy ſail, having the whole night before us; and by three next morning we got out the length of the Edyſtone. As the tide had overhauled us, and driven us to the eaſtward of our proper mooring-place, we let go an anchor and warped the buſs to her proper *birth*: but before we could *ground* our weſtern anchor, the tide of ebb ſet ſo ſtrong as to carry us too much to the weſt; we therefore deſiſted for the preſent, till the ebb abated, and landed on the rock, unloaded the Edyſtone boat of her cargo, and ſet a part of it. We returned to the buſs about noon to get down our moorings, which we happily compleated by four P. M. much in the ſame manner we had originally done § 126; our eaſtern anchor lying amongſt the rough rocks in fourteen fathoms, and our weſtern in ſixteen fathoms water; the houſe bearing by the compaſs S. W. by W. diſtance about 200 fathoms.——And here I muſt obſerve, that one misfortune frequently becomes a conſolation for another; for if none of thoſe accidents had befallen us, if our buſs had kept its ſtation and all our eſſentials had duly performed their duties, we could have reaped little advantage from them; for we had repeatedly experienced that the progreſs of the work was by no means proportioned to the length of time that the buſs continued at her moorings; ſo that, from the time of our firſt going out with the buſs to this day, winds, ground ſwells, and ſeas, had afforded ſo few opportunities of forwarding the conſtruction, to any material purpoſe, that in fact we had loſt little or no time; and our principal ſufferings were from that vexation and trouble of mind, which ſuch diſaſters are apt to produce.

251. FROM

251. FROM the 2d to the 5th inclusive we began and finished the Xth Course; and by noon on the 6th we had set the center, and two of the surrounding stones of Course XI; I therefore left Mr. RICHARDSON and company to proceed; and, as the method was the same as has been particularly described in the course of last year's work, there will be little further occasion to trouble my reader with any account of the building work; except to mark its progress, with the incidents attending, and such *alterations* in the method, as were necessarily occasioned by the different modes of construction, which the different purposes naturally required.——Our present run of fine weather was not lasting, for though we compleated the Xth Course in four days, it was not till the 18th (twelve days longer) that the XIth Course was finished. However, the seamen that were relieved upon the 16th brought word that the buss had rode it out very well, without being under the necessity of veering out any more cable.

252. ON the 17th at midnight I went out, and found RICHARDSON and company at work delivering the Assistant's cargo, that had been on board ten days; and by the 24th the XIIth Course was finished; as was the XIIIth the 5th of August; and on the 8th of that month the XIVth was compleated, and therewith the *Fundamental Solid*.——From hence begins that part of the building, also called *the Solid*, which includes the passage from the Entry-Door to the *Well-Hole* for the stairs. The Plates N° 11. Fig. 2, 3, and 4; together with the Section N° 9, will explain, by inspection, the construction and proportion of these parts much better than words; I shall therefore think it sufficient to say, that as, for the sake of the well-hole, we must necessarily lose our *Center Stone*, the four stones surrounding it that in the former courses were by four dovetails united to the center stone, were, as now prepared, to be united to each other by *Hook-Scarf-Joints*, so as to compose, in effect, one stone: and as, in consequence, we had also lost our center cubes, it became expedient, that the work might have an uniform texture and strength, that those four stones, making a compleat circle for the stair-case, should be provided with cubes to prevent their being shifted by any shock applied horizontally, (see Fig. 4.) as well as with trenails to hinder them from lifting. By this means the *principle* of consolidation would be effectually preserved: but as the top of the XIVth or Entry-door Course, was twelve feet above the top of the rock, that is, twenty feet four inches above the base of the Ist Course, the stroke of the sea must here become less violent, and therefore a less degree of resistance would be equally sufficient. And as the large cubes would too much cut the work, which was here of considerably less *area*; and as several cubes would be requisite for the *Well-Hole Stones*, I had determined, above the Entry-door Course, to increase the number of cubes from eight to sixteen, and to diminish their size from twelve to six inches; but still to be of solid grey marble, and two of them to be introduced into each of the four well-hole stones.

253. UPON the 9th of August at two A. M. I landed on the rock, and marked out the Entry and Stair-case; and having unloaded the Edystone boat, which was loaded with the first pieces of Course XV. we immediately proceeded with it; and from this time were blessed with such an uninterrupted continuance of fine weather, that upon the 20th day of August the XVIIIth Course was compleated, which reunites the building into a compleat circle by covering the passage to the stair-case: the external face of the stone of that course, which makes the cover or *head* of the entry door, having the figures 1758, denoting the year in which this part of the work was accomplished, cut, in deep characters, upon it. During this fine season we had however one accident, that might have proved of bad consequence, if Providence had not interposed. Upon the 15th, while all the people were at work upon the building, and the yawls attending in the Gut, by some accident the hook by which the *in-hauler* guy of the shears was attached, became undone; and in consequence the shears came forward, overset into the Gut, and falling upon one of the yawls considerably damaged it, and hurt two of the workmen, so that they were obliged to be sent home to the care of a surgeon; but they were soon recovered, and returned to their work with their company the next turn.

254. ON the 24th of August the fine weather, and in consequence the works, were interrupted, the XXth Course being then in hand; and it was not till the 24th of September that, with every possible

exertion,

exertion, the XXIVth Courſe was finiſhed; which compleated *the Solid*, and compoſed the floor of the *Store-Room*.——During this month of froward weather, it happened upon the 30th that the men, who went in the yawls to help the Aſſiſtant out of the Gut, after ſo doing, the wind becoming freſh at E. with a ſtrong tide of ebb, were not able either to get on board the buſs, or land upon the rock; ſo that thoſe remaining upon the rock could not get on board the yawls: thoſe in the yawls were therefore under the neceſſity of lying upon their oars all night, in the wind and rain, to the leeward of the building; thoſe upon the rock amuſed themſelves with their work; which, having their lanterns and candles, they were enabled to do. On the morning of the 31ſt the wind abated, and they got happily off without any other harm, than that there was not a dry thread amongſt the whole company. This was the firſt and only time that either company were ever detained upon the rock: and, conſidering the number of eſcapes we had had, it was rather ſurprizing that this had not happened oftener.

On Wedneſday the 6th of September it blew a ſtorm, and when I landed on the 8th I found the forelock, which faſtened the foot of the ſouth leg of the ſhears, broken, and the two legs driven together: but the houſe being now almoſt as high as the top of the ſhears, the in-hauler guy tackle had been hooked to a lewis in the floor of the top of the building, which ſupported the ſhears from falling, otherwiſe they muſt have been deſtroyed, as happened before about the ſame time laſt year. (See § 232.) No other part of the tackle however had received any injury.

255. IT being, as ſaid, the 24th of September when we finiſhed the ſolid, had nothing been further in view than the completion of the building the *next* year, I certainly ſhould have been very well contented now to have put a period to this year's work; but, conceiving it would be of great utility to the public, I had been for ſome time paſt meditating upon the practicability of exhibiting a light from the houſe during the enſuing winter, provided we could get the *Store Room* compleated; of which I thought there was little doubt, when I conſidered how much leſs of ſolid ſtone was neceſſary to raiſe one room with its vaulted ſtone cover, than was neceſſary to finiſh as much in height of the ſolid; and that for the execution of this, every thing was ready in the yard for putting together.——Accordingly, upon the 28th of September I wrote to the proprietors; and alſo gave an account of the advancement of our works to the Board of *Trinity Houſe*; intimating the practicability thereof, in caſe I could get the *Store-Room* compleated: and alſo the probability of doing it, as it certainly could be effected in eight or ten days of working weather. I alſo ſet forth the general outlines of the method, by which I propoſed to do it; which was, that beſides making good the ſtone floor above the ſtore-room, a ſtrong platform of timber was to be laid over all, and that covered with a *Tarpaulin* well ſecured down. Upon the middle of this platform I propoſed to ſet up our triangle, wherewith we hoiſted and ſet our ſtone; the legs to be well laſhed down, and to ſuſpend the *Lantern* thereon that was made for the *Neptune Buſs*: and, as nothing would project beyond the circumference of the area of the top of the building, the lantern being in the center would be effectually ſcreened from the ſtroke of the ſea; and every thing would be ſufficiently ſtrong to reſiſt the falling *broken water*, which would immediately ſhoot off from the platform: and as I meant to lay three floors in the well-hole, I could convert the whole of that cavity, as well as the paſſage, into ſtore-rooms, ſo as to make ſufficient conveniency for *two* men, which appeared to be all that was *abſolutely* neceſſary for the keeping a light.——As I doubted not but this propoſal would be approved, and there was no time to loſe, I went on with it in the ſame manner as if I had received an order for that purpoſe; and I not only got prepared the wooden platform and tarpaulin, but fixed with two of my hardieſt workmen to keep the light for the winter; which for *double* their conſtant wages they agreed to undertake: and as, under theſe circumſtances, our platform would be full forty feet above the baſe of the building, and every thing very ſubſtantial, I did not doubt but that my two men would fare much better in the year 1758, than Mr. WINSTANLEY's did in 1698; and quite as well as Mr. RUDYERD's could do in the year 1708*.

256. THE 25th and 26th of September Courſe XXV. being the firſt courſe of the ſuperſtructure, was ſucceſsfully compleated in its place; but as the mode of conſtruction now became entirely different

* See Mr. Winſtanley's account § 20 and 21; and Mr. Rudyerd's § 34 and 50.

from

from the former, it becomes neceſſary to give an account thereof, as alſo of the reaſons for the change. The building was carried up ſolid, as high as there was any reaſon to ſuppoſe it expoſed to the heavy ſtroke of the ſea, that is to thirty-five feet four inches above its baſe, and twenty-ſeven feet above the top of the rock, or common ſpring-tide high-water mark. At this height, as it was reduced to ſixteen feet eight inches in diameter, it became neceſſary to make the *beſt uſe* of this ſpace, and make all the room and convenience therein that was poſſible, conſiſtent with the ſtill neceſſary ſtrength.——The rooms being made of twelve feet four inches diameter, this would leave twenty-ſix inches for the thickneſs of the walls. Theſe being made with ſingle blocks in the thickneſs, ſo that ſixteen pieces might compoſe the circle, would, from its figure, compoſe a ſtout wall; yet moorſtone, as has been obſerved, being a tender kind of ſtone in reſpect to the union of its component parts; any method of dovetailing the blocks together at this thickneſs, appeared to me impracticable to any *good* purpoſe. What ſeemed to be the moſt effectual method of bonding the work together, was that of *cramping* with iron, which would confine each ſingle piece to its neighbouring piece in the ſame circle: and if to this be added, that every piece ſhould, at *each end* of it, lay hold of an *inlaid* piece, or *Joggle*, in the ſame nature as the cubes, then not only all the pieces in the ſame courſe would be united to each other by the cramps, but ſteadied from moving upon the under courſe by the joggles, and of conſequence would be faſtened at thirty-two points; for, in each courſe there being ſixteen joggle ſtones, as each end of each principal piece, at its baſe, took hold of half a joggle, there would be thirty-two points of confinement in the circle above; that is, the joggles being made to occupy the middle of the upper bed of each block, in that ſituation they would croſs the joints of the courſe above. Theſe joggles, as well as the reſt, were of ſawn marble, and made eight inches long, four inches broad, and three inches thick: each end of each block therefore would occupy four inches in length, four in breadth, and 1½ inch in the height of each joggle; and this I judged quite ſufficient to keep every courſe in its place, at the height that this kind of work was begun, and ſo as to conſtitute a piece of ſolid maſonry. There was however another matter, that it ſeemed quite material alſo to attend to; and that was, to render the habitable rooms contained within thoſe ſhells of walls, perfectly *dry* and comfortable in all weathers; and this was a matter that ſeemed to merit very particular attention; for the ſeas that are ſaid to riſe up againſt, and in a manner to *bury* the houſe in time of ſtorms, (ſee § 21.) would make effectual trial of every joint.

The level joints being preſſed together by the incumbent weight of the building, would keep firm and ſound that coheſion of parts produced by the mortar; ſo that being once made *water-tight*, there was no doubt but they would ſo remain: but with reſpect to the upright joints, the *leaſt* degree of ſhrinking, either of the ſtone or of the mortar between, tended to open the joint, ſo that it might always remain leaky in a greater or a leſs degree; for we know of no degree of ſeparation of parts, however minute, ſhort of abſolute contact, which will ſtop or prevent the percolation of water. For this purpoſe I conceived, that if flat ſtones were introduced into each upright joint, ſo as to be lodged partly in one ſtone, and partly in its neighbour; much upon the ſame idea, that *Dutch* laths were formerly introduced into the joints of chamber floors, to hinder the paſſage of wet; the water might be prevented from making its way through the upright joints of the walls.

The manner in which it was executed was as follows, (ſee Plate N° 11. Fig. 6.) At each end of each piece of ſtone, anſwerable to the middle between the inſide of the wall and the outſide, was ſunk a groove 2½ inches wide and three deep, running from the top to the bottom: when therefore two contiguous pieces of ſtone were put together in their places, the two grooves being applied to each other, they would form a *Rhomb* of ſix inches in length, and 2½ inches in breadth, which in this ſtate would be an unoccupied cavity from the top to the bottom of each courſe; the reſt of the joint, where the ſurfaces of the two ſtones applied to each other, was made good with mortar in the ordinary way, and brought together by the *gentle* blows of a beetle. For the groove mentioned, a ſolid *Rhomb* was prepared, of about two inches thick by five inches broad, and in length a little leſs than the depth of the cavity, which generally was eighteen or twenty inches; and for the ſake of firmneſs of thoſe ſlender pieces of ſtone, I made choice of the flat paving ſtones from *Purbeck*, which, as mentioned § 100, is a laminated marble of great ſtrength and ſolidity. The *Joint Stones* (which was the name we gave thoſe *Rhombs)* thus prepared, would readily go down the cavities; but to fix them ſolid, a quantity of well-tempered mortar was prepared, made more

ſoft than ordinary, by the addition of a little water; a competent quantity being put down to the bottom of the hole, the joint ſtone was put down upon it; and, by the ſimple preſſure of the hand, was forced down to the bottom, cauſing the ſemifluid mortar to riſe up to the top, and compleatly fill the cavity: and when forced down in the way deſcribed, having in this ſtate a ſmall quantity of ſuperfluous moiſture about it, a few *very* gentle blows or raps were given upon the top of it by the handle of a maſon's trowel, which producing a ſmall degree of agitation, while the dry ſtones were abſorbing the moiſture, contributed (like the beating of mortar) to bring all the parts into their moſt *friendly* ſtate of contact, and in conſequence, to their firmeſt ſtate of union; and this happened in the courſe of a few minutes, ſo that no further agitation could be of any ſervice.

As the cramps, that were to bind the contiguous pieces together, muſt croſs the joints upon their upper ſurface, they were of courſe to be applied *after* the joint ſtones were ſettled in their places. Precaution was therefore neceſſary not to apply too much exertion in forcing down the joint ſtones: for, however gentle the operation may appear, according as it has been deſcribed, yet it was found adviſable not to put in the joint ſtones till an additional piece had been got down upon its joggles, and plain jointed, at each ſide of the two pieces, whoſe joint ſtone was to be put in; for by this means there were the united efforts of all the joggles, and adheſion of the beds, of two ſtones on each ſide of that where the effort was applied. Without an attention to this, the lateral force ariſing from merely preſſing down a joint ſtone, was capable of breaking the adheſion of the joint where it was applied.

257. THE cramping was applied the laſt thing. The top or *flat bars* of the cramps were about thirteen inches long, two inches broad, and ½ of an inch thick, and were turned down at each end about three inches in length; forming a cylinder of 1½ inch diameter. Jumper holes were previouſly bored when upon the platform, and the cramps fitted to their places; the ſurface of the ſtone under each cramp being ſunk ¼ of an inch, ſo that the two ſtones together would compleatly receive, or rather bury, the cramps: the joint ſtones, as ſaid above, being made ſo much ſhorter than the height of the courſe, as not to interrupt the bedding of the cramp. The places for the cramps being properly fitted and cleared (as we now were not liable to be driven off the work in a moment, as had formerly been the caſe) we took the opportunity, whenever time allowed it, of fixing the cramps of a whole courſe together. There was no danger of the cramps not fitting; as, beſides that all the cramps were forged to fit a gauge-bar having a couple of holes at the aſſigned diſtance, they were alſo fitted and marked to their particular places at Mill Bay, while upon the platform.——Every cramp being now ultimately tried to its place, it was then put into a kettle of lead made red hot; and the cramp continued there till it was alſo reddiſh. About a ſpoonful of oil was poured into the two cramp-holes, and the cramp being put into its place, the ebullition of the oil cauſed by the heat of the iron, quickly gave a compleat oily ſurface, not only to the whole cramp, but to the whole unoccupied cavity in the ſtone; then the hot lead being poured upon it, the unctuous matter cauſed the metal to run into and occupy the moſt minute cavity unfilled, and compleatly to cover each cramp; and they became by this means defended from the ſalts of the ſea, even had they remained *uncovered*, upon Mr. RUDYERD's principle*: but as every cramp, from conſtruction, would be covered by the middle of the baſe of the ſtone in the next courſe above, it became defended from moiſture in the moſt effectual manner poſſible; and thus by cramping in general a whole courſe together, the contraction of the iron in *cooling* would greatly add to the tightneſs wherewith every ſtone was bound to its fellow.——Thus, according to this mode of fixing, (beſides the union of the parts by the mortar itſelf) to reſiſt all violence and derangement whilſt it was doing, and before the induration of the mortar, every courſe was retained in its place by ſixteen joggles, and each ſingle ſtone by two half joggles at its lower bed; they were further ſteadied to each other by the joint ſtones, and laſtly by the cramps, which compleatly prevented a ſeparation: and this method proved ſo effectual, that we were not only free from all derangement of the ſtones, when in their places, but I did not find a leaky joint, except one, in the whole building. By a due conſideration

* § 37.——It is there ſaid that inſtead of *Lead* Mr. RUDYERD had uſed coarſe *Pewter*. The lead we uſed was *flag Lead*, which is harder and ſtiffer than fine lead: and as we uſed no cramps, as an *eſſential* part of the building, till above the ſtore-room floor, I judged pewter, merely for the ſake of ſtiffneſs, *there* to be unneceſſary.

of

of Plate N° 11. with the particular references to it, the whole of this proceſs will become perfectly intelligible.

258. ON Saturday the 30th of September, Courſe XXVIII. was compleatly ſet; and being the firſt courſe, upon which was reſted the vaulted floor, which made the cieling of the ſtore-room and floor of the *upper* ſtore-room; and, as here again occurred a difference in the mode of fixture, in this, as in all like caſes, I attended the performance of the work: and that was the *leading* in of the firſt *circular chain*, that was lodged in a groove cut round the middle of the upper ſurface of this courſe; which this day was ſatisfactorily performed; and the next day, Sunday October the 1ſt, Courſe XXIX. was ſet, and its circular chain leaded in alſo; which operation, with the reaſon thereof, it will be proper here to deſcribe.

The ordinary way of fixing the ſeveral courſes by joggles and joint ſtones; and alſo the bonding them together by cramps, has already been deſcribed; but thoſe courſes, upon which the floors reſted and depended, ſeemed to demand every *poſſible* ſecurity.——It will be ſeen in the general ſection, Plate N° 9, that each floor *deſignedly* reſted upon two courſes: it will alſo appear, by inſpection, that the circumference of the floors was not made to reſt upon the ſloping abutments of an arch, in lines tending towards the center of the ſphere, of which the under ſide of the floor was a portion, but it reſted upon a triple ledge going circularly round the two ſupporting courſes. In conſequence of this, had each floor been compoſed of a *ſingle* ſtone, this lying upon the horizontal bearings furniſhed by theſe ledges, would, while it remained entire, have no lateral preſſure or tendency to thruſt out the ſides of the encompaſſing walls*: and that, in effect, the ſeveral pieces, of which the floors were really compoſed, might have the ſame property as *whole* ſtones; the center ſtone was made large enough to admit of an opening, from floor to floor, or *Man-Hole*, to be made through it; and being furniſhed with dovetails on its four ſides, like thoſe of the entire ſolid, it became the means by which all the ſtones in each floor were connected together; and conſequently, the whole would lie upon the ledges like a ſingle ſtone, without any tendency to ſpread the walls. But, if by the accident of a heavy body falling, or otherwiſe, any of thoſe ſtones ſhould be broken, though this might not deſtroy its uſe as a floor, or its properties as an arch; yet the parts would then exert their *lateral preſſure* againſt the walls: and therefore, as a ſecurity againſt this, it became neceſſary that the circle of the incloſing walls ſhould be bound together, and the building, as it were, *hooped*.

This would be in a great meaſure brought about, by the cramps tying the neighbouring ſtones together, as already deſcribed for the ordinary courſes; but yet this was no abſolute ſecurity, becauſe the outſide ſtones might break and ſeparate, between cramp and cramp: and I ſuppoſe it was for reaſons of this kind, that Sir CHRISTOPHER WREN, in the conſtruction of the *Cupola* of *St. Paul's*, did not chuſe to depend upon cramping the ſtones together, of the courſe that ſerved as a common baſe to the inſide dome, and the cone for ſupporting the lantern; but choſe to ſurround the whole with continued chains of iron†.—— Upon this principle, an *endleſs* chain was provided for each of the two floor courſes, ſee Plate N° 11. Fig. 7. The bars compoſing the links being 1¼ inch *ſquare*; that the moſt iron might be included in a given ſpace, the corners only were a little canted off; and the double parts being brought near together, the whole was comprehended in a groove, of ſomewhat leſs than four inches wide, and as much in depth; into which the chains being introduced and brought to a ſtretch, the reſt of the cavity was filled with lead; of which each took about 11 cwt.

Had the author of the *Parentalia* informed us particularly how this was done, it would have been uſeful to me to have known it. It is obvious that it muſt be in a manner impracticable to heat chains of ſuch a length as even ours, in the manner I treated the cramps; or that the whole of the circle could be run at once: becauſe if ſo attempted, the metal firſt poured in would have ſo *far* to run, that one ladle-

* This method of abutting by ledges alſo prevented the ſhell of the walls from being unneceſſarily thinned by a longer continuance of ſloping lines.

† "Although the dome wants no butment, yet for greater caution it is hooped with iron in this manner. A channel is cut in the bandage of Portland ſtone, in which is laid a *double* chain of iron ſtrongly linked together at every ten feet, and the whole channel filled up with lead." WREN's *Parentalia*, p. 294.

full

full would cool and ſet, before another could be put down upon it; ſo that the maſs of lead, inſtead of enveloping the iron of the chain, as one ſolid piece, and thereby excluding all moiſture, would in many places be compoſed of *Laminæ* without any firm coheſion.——In our work, it was performed in the following method. The chains were oiled all over before they came from the ſhore; and the circumference of the groove was divided into four parts by ſtops, or dams of clay; to prevent the lead from flowing further than one quarter at a time. A couple of iron kettles were provided, capable of melting commodiouſly, when full, ſix cwt. of lead each; and that quantity was brought in each to a *full* red; that is, ſomewhat hotter than we uſed for the cramps, as the iron of the chain as well as the ſtone were cold. The whole quantity of lead being brought to a heat that we judged proper, and the quarter groove being ſupplied with oil ſufficient to beſmear the whole ſurface, two perſons with each a ladle, as briſkly as they could, poured the melted metal into the ſame quarter of the groove; and as ſoon as it was full, and the lead began to ſet, one of the clay dams was removed, and the melted hot metal was poured upon the end of the former maſs, till it was perceived to re-melt and unite with the freſh metal. This done, the dam at the *other* end of the firſt run maſs was taken down, to prevent its cooling more than was neceſſary, and the third quarter was treated like the former; the end of the maſs rendered ſolid by cooling, being re-melted by the freſh hot metal: laſtly, both the remaining dams being taken down, and the metal at each end having a conſiderable heat, it was found practicable to diſſolve both the ends of the former maſſes; firſt applying both ladles to that which had had the greater time to cool, and afterwards to the leſs: by this means the whole was brought to a ſolid conſiſtence, and the chain entirely buried in the lead.——It is however to be remarked, that to preſerve proper impreſſions in the lead, for the joggles of the courſe above, thoſe impreſſions were made by confining down bricks in proper places, which when removed, the proper marble joggles were ſet with mortar in their places.——Thus the floor courſes were in effect *hooped*; and the hoops ſecurely protected from moiſture and ruſt; firſt by a coat of oil together with a body of lead; and ſecondly by the whole being lodged in the middle of the wall.

Some may perhaps think this extreme precaution of the chain courſes, and the forming of the *floors* upon a ſyſtem of dovetails, might have been diſpenſed with; and probably it might, if the whole of this work muſt have been executed upon the *Edyſtone Rock*; but it is to be remembered that the iron chains were executed on *ſhore*, at ſo much per cwt.; were fitted to their places in the work-yard at *Mill Bay*; and the *extra* work in the jointing of the floors was the produce of ſo many days work of a ſtone-cutter in the ſame place: ſo that little extra expence attended the fixing at the rock, except a little more *Lead*, and a little more *Fire*.

259. MONDAY October the 2d we proceeded to ſet up the centre, compoſed of ſixteen ribs, (ſee Plate N° 18. Fig. 3.) for putting the floor together upon; but I muſt here note, that having the evening before had the opportunity of landing the five large ſtones compoſing the middle of the floor; thoſe were, previous to the ſetting up the centre, got up upon the top of the wall; for all the reſt could be got up through the man-hole left in the middle of the centre, anſwerable to that of the centre ſtone; and this afternoon we landed all the remaining pieces belonging to the floor, being in the whole thirty-ſeven; which we lodged in the well-hole for the ſtairs, and in the ſtore-room under the centre. This I was not a little anxious to get done; for we had now got into the building every piece of ſtone that I had it in view to ſet this year, as neceſſary for the eſtabliſhment of a light; but this ſolicitude had nearly coſt us our boat the *Weſton*; for though the paſt week had been the fineſt this ſeaſon, yet before the boat could be got out of the Gut, it began ſuddenly to blow ſo freſh at E. that it was not without the greateſt difficulty and exertion, that ſhe was got out of it without damage.——Being myſelf wanted at Mill Bay, to forward our equipments for rendering the houſe habitable, I returned in her to Plymouth; and, as rough weather came on, I got that work well advanced. I went out again on Thurſday the 5th, and ſaw the two firſt ſtones of the floor ſet in their places in the outward circle *; but after doing this, we had ſome riſque and diffi-

* In ſetting the floors we begun with the outward circle of ſtones, becauſe at all adventures they were to fit the outſide ſhell of the building; and if ſet laſt they would not have gone into their places.

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culty in getting aboard our yawls. The company before my arrival had employed themſelves in getting down the windlaſs and ſhears, as having no further occaſion for them this ſeaſon.

The weather continued broken till Saturday the 7th, on which day the Edyſtone boat came out, having on board the roof or platform, for covering the building, and protecting it, as mentioned, from the entrance of the downfall ſpray; together with the doors, iron-work and timber for fitting up the ſame for habitation; *Coals*, *Water*, &c. and the carpenters for fixing thoſe temporary works. This afternoon we landed, and went on with the ſetting of the outward circle of floor ſtones, made the holes in the wall for fixing the hinges of the entry and ſtore-room doors; and did not doubt but that *one* favourable day, would enable us to compleat this floor; and then we propoſed to begin directly to lay on the *Platform* roof; which would be perfected in two or three hours: and as this being done would render the building water-tight; we then intended immediately to make a *lodgement* therein, and go on to the entire completion of this temporary part of the work; however, towards evening, while we were proceeding, a ground ſwell began to come on, and to ſuch a degree as reminded us of the neceſſity of retiring, though two ſtones were wanted to compleat the outward circle, (ſee Plate N° 11. Fig. 7.); and as the ſky began to look *foul-weather-like*, I endeavoured to ſee every thing put into the *beſt* poſture for receiving a ſtorm. In particular, I cauſed the middle ſtone to be laid upon the *centre*, by way of weight, to keep it ſteady. Three of the four ſtones that were to connect with the centre ſtone were laid upon the top of the wall on the N. E. ſide; and the fourth I cauſed to be hoiſted and ſuſpended upon the triangle, in the poſture that is ſhewn Plate N° 14. at Stage 2nd. So that the triangle, which was all of it compleatly within the area of the top of the building, would be kept down by the weight of this ſtone, which was between ſeven and eight cwt. ——The other three that lay upon the wall, I cauſed to be carefully drawn within the circumference thereof, ſo that there might not be the leaſt projecting part for the water to ſtrike againſt in flying upwards; which I judged quite neceſſary, though the walls were then upwards of forty-three feet above the foundation ſtone, and near thirty-five feet above the top of the rock. After righting all matters to our ſatisfaction, we had again an eſcape in getting into our yawls.

In the night the wind came to S. W. and S. and in the morning the ſwell was ſo great as to oblige the Edyſtone boat to quit the moorings: and as I wanted to be at Plymouth to expedite and finiſh our intended equipment and ſtores, which I had greatly at heart, and we were not likely to proceed ſoon to buſineſs, I left orders with Mr. Jessop for the compleating of the floor, and took my paſſage home in the boat.——The evening of this day, Sunday October the 8th, it blew a ſtorm, the men of war in the Sound frequently firing guns of diſtreſs. About break of day on Monday morning the wind ſuddenly veered to N. W. but it ſtill blew very hard.

260. THIS morning, October the 9th, I went up to the *Hoa* to look out with my glaſs; I could juſt diſcover the houſe, and the ſea breaking over it, ſo as at intervals entirely to bury it, but could diſcover nothing of the *Buſs*; however, the air being very hazy, the hull of that veſſel being low, and its maſt a ſmall object, I judged that to be the reaſon I could not ſee her.——In the afternoon, the air being ſomewhat leſs hazy, I looked out again; the ſea was breaking over the houſe as before, but ſtill no buſs was to be ſeen, which created ſome apprehenſion for her and the people.

Tueſday October the 10th I again went up to the *Hoa*, and though the wind had remained freſh at N. W. now above twenty-four hours, yet the ſea was ſtill breaking over the houſe, riſing up in the form of a white pillar, conſiderably higher than the building, and of ſuch magnitude as at times to intercept every part of it from view: but the air being now more clear, in the intervals of its retreat, I could diſtinctly perceive the triangle ſtanding upon the houſe, and the ſtone ſuſpended thereon; but to my great mortification, found that the buſs was really gone from her moorings, and no where to be ſeen.——This, in reality, turned out a day of thorough regret; for, beſides the uncertainty of the fate of the *Neptune Buſs*, it brought me the reſolution of a *General Court* of the *Corporation* of Trinity Houſe, upon my propoſal of the 28th of September, for the exhibition of a light upon the houſe during the winter; which more effectually put a ſtop to all further attempts to proceed this year, than the parting of the buſs from her moorings. Their anſwer was to this purport: that having taken into conſideration the propoſals

mentioned § 255.) " on reading the acts of parliament, the application from the merchants and owners " of ships, the patent for the floating light, and the incloſed *Narrative* of the firſt light-houſe erected " there*, they are of opinion, that a light cannot be exhibited on the Edyſtone rock till the light-houſe is " re-built."——This rebuff, I own, mortified me much, not only that I ſhould in *appearance* fall ſhort of the expedition which my predeceſſors Mr. WINSTANLEY and Mr. RUDYERD had ſhewn, to procure the public a temporary light in the courſe of the *third* ſeaſon; but that my exertions on this head were fruſtrated†.

261. THIS evening at ten Mr. JESSOP returned to Plymouth, and, to my no ſmall joy and ſatiſfaction, brought me an account that the buſs was ſafe at anchor in *Dartmouth Harbour*.——He further informed me, that on Sunday, about two hours after I left them, it began to blow a ſtorm at S. S. W. and that in conſequence thereof he ordered the decks to be cleared, and every thing put in order; but did not *bend* the main-ſail, becauſe, by holding wind, it might be the occaſion of their breaking looſe. Towards night however the ſtorm increaſed, and the ſea frequently intercepted from them all ſight of the building, as the broken column of water roſe conſiderably higher than the top of the triangle: that at night the ſtorm ſtill increaſed, and about eleven o'clock the cable parted at the *Bows*.——Upon this they hoiſted their fore-ſail and mizen, and endeavoured to ſtand in for the land; but the ſea proved ſo tempeſtuous, that with the little quantity of ſail they had, they could not keep a proper ſteerage; and it being alſo exceſſively rainy and dark, they were afraid of running on ſhore before they could ſee it: they therefore determined to lay her *to*, with her head to the S. E. that they might have daylight before they drove to the land. About two o'clock the wind came to the W. and at break of day they found themſelves about three leagues from, and abreaſt of the *Start*. They then bent their main-ſail, hoiſted their *Jib*, and ſtood in for the land with the wind at N. N. W. (ſee the Chart N° 1.); but the Neptune buſs was ſo ſlow a ſailer, that it was four P. M. before they got off *Dartmouth*: they then, by the help of a pilot, came to an anchor in the *Road*, and the next morning warped into the harbour; and after ſeeing the veſſel ſafely moored, Mr. JESSOP and part of the workmen made the beſt of their way to Plymouth.

Wedneſday October the 11th JOHN BOWDEN was ſent with one of the ſeamen over land to Dartmouth; the former to take charge of, and the latter to aſſiſt in bringing the buſs round to Plymouth, as ſoon as the wind ſhould prove fair.——This day the wind continuing at N. W. and having become ſo moderate as to produce ſmooth water in Plymouth Sound; though I now laid aſide all further idea of carrying out the buſs to her moorings again this year, we prepared every thing on board the Edyſtone boat and Aſſiſtant to go out with a competent ſet of workmen the next morning, to do whatever might appear neceſſary upon the building, after ſuch a trying ſtorm; and at leaſt, if poſſible, to ſet the two remaining pieces of ſtone, that were wanted in the outward circle of the vaulted floor; for that being done, the *centre* might be taken down, as every circle of ſtones would ſupport itſelf: and I was deſirous, if it ſhould be found practicable, to do ſomething to ſecure the *Moorings*; there being only one buoy, upon one of the anchors. ——Every thing was thus prepared, but early next morning there came on a freſh of wind at E. which rendered it to no purpoſe to attempt to go out.

The wind continued freſh at E. for ſeveral days running, and brought home the buſs, which was moored in Mill Bay on Friday evening: and on Sunday came on a ſtorm at E. and a continuance of bad weather from the ſame quarter.——Nothing therefore being *neceſſary* further to be attempted, and every thing going on well in the yard under the care of Mr. TYRRELL, I left the neceſſary orders what to do, in caſe of favourable weather, and every thing to the care of Mr. JESSOP; and took my departure for London on the 25th of October: after which, no further events, of conſequence to this buſineſs, happened in the remainder of this year.

* The narrative referred to was an extract from that of WINSTANLEY, recited § 17 to 27 inclusive.

† It is very poſſible I might not at that time have reflected, that we heard nothing of any *floating* light being *then* maintained; ſo that till a *temporary* light was erected *upon the Building* itſelf, the public were not ſerved with *any* light.

CHAP.

CHAP. III.

Containing an Account of the Tranſactions of the FOURTH *and* LAST YEAR'*s Work, to the finiſhing of the Building in the Year* 1759.

262. DURING my ſtay in London, in the early part of the year 1759, I received regular accounts of the proceedings at Mill Bay, which were carried on with all the diſpatch I could wiſh, while I was myſelf forming and making out the neceſſary deſigns for the iron rails of the balcony, the caſt iron, the wrought iron, and the copper works for the lantern; which, together with the plate glaſs work, were all done in London. The weather having continued unfavourable to viſiting the works at the Edyſtone during the winter, I got no report thereon till I received Mr. JESSOP's letter dated the 27th of March, wherein he informed me that on the 21ſt of that month, being the firſt opportunity he could catch after the violent ſtorm which had happened on the 9th preceding, and which had done very great damage to the ſhips, houſes, and buildings at Plymouth; they put to ſea, and at a diſtance obſerved the triangle ſtanding, with the ſtone hanging upon it, as it was left at the concluſion of the laſt ſeaſon's work; ſo that when they had got by the Edyſtone, and doubted not but to have laid hold of the *Tranſport Buoy*, they found it was gone! whereupon they came to an anchor; and getting into the ſmall boats, went into the Gut and landed. They found not only the ſolid but the hollow work perfectly ſound and firm; all the mortar having become quite hard; and in ſhort every part of the work in the ſituation in which it was left by the workmen in October: the only derangement was, that the ſea had carried away the ſouth fender pile from the rock; and alſo, from the top of the wall, one of the three ſtones that I had taken care to draw within the verge of the circumference of the wall, as mentioned § 259. That they had found the fourteen pieces of ſtone ſet in the circumference of the floor, ſtuck quite firm to the wall, though two of the pieces requiſite to complete the circle were left unſet; and that, finding the *centre* itſelf quite tight and firm underneath them, they had lowered down the ſtone ſuſpended on the triangle upon it, and removed from the wall the other two remaining ſtones to lie upon the centre; and laſtly, that they took down the triangle and ſtowed it away in the well-hole for the ſtairs: but, on further ſearch, nothing of the buoy that was left upon the mooring chains was to be ſeen. Mr. JESSOP alſo informed me, that he had put in hand a new tranſport buoy, and was preparing a ſouth pile; that he had given the neceſſary orders for fitting out the buſs to ſweep for the moorings; and that the XLVth Courſe was then upon the platform*.

After this the ſeamen went frequently out, and often ſwept for the moorings, but without ſucceſs; although the proprietors had offered £. 10 as a bounty to the ſeamen in caſe they recovered one ſet of the moorings, and £. 20 in caſe they recovered both ſets.——I then propoſed the ſweeping with a cord, every yard of which to have a lead upon it like thoſe uſed for nets, which by ſinking into the hollows of the rocks might lay hold of the *fluke* of an anchor; and thereby aſcertain its place, which would facilitate the laying hold of it with a proper pliant ſweep rope, as mentioned in the operations of laſt year (ſee § 242.) This Mr. JESSOP made trial of, and informed me that after a conſiderable time ſpent, it had proved ineffectual; ſo that now, looking upon the recovery of our moorings as hazardous, I thought it time to ſet about the providing a new ſet. Accordingly, the 29th of May I ordered forty fathoms of new chain to be made at *Blackwall*, intending to ſend it down by land; and this, with ſome old chain purchaſed in

* This courſe makes the chain courſe for ſpringing the arch of the balcony floor, and forms the cove on the outſide.

Wapping

Wapping laſt year, which we had then at Plymouth, and was thought ſufficient for our eaſtern chain if occaſion required; I judged would ſerve our purpoſe for the preſent year, in caſe we could not recover any of the others: and Mr. JESSOP was alſo directed to look out for a couple of anchors ſuitable to our purpoſe.

263. THE caſting the corner pillars for the lantern being attended with ſome difficulties, to which the ordinary workmen in the caſt iron foundery *at that time* were not equal, I was recommended to Mr. PRICKETT, then of *Farthing-Fields*, Wapping, whom I found equally intelligent and ingenious, and who executed my buſineſs to perfect ſatisfaction*.——The caſting of ſaſh frames of copper, each in one piece, was a difficulty I was deſirous to ſee accompliſhed before I ſet out for Plymouth. The inſpection of Plates N° 12 and 15, will give my reader an idea of this buſineſs as well as the former, eſpecially if he alſo conſults the technical deſcription of thoſe plates.——Thoſe copper frames, conſiſting of nine panes each, being ſixteen in number, were ſucceſsfully caſt by Mr. KINMAN of *Shoe Lane*; a work which did him credit.——The fitting together of the whole work of the lantern with wrought iron framing, as alſo the balcony rails, I ſaw in good forwardneſs, and left in the hands of Mr. BROADBENT, an *Engine*-maker, in *Piccadilly*; of which work he acquitted himſelf to full ſatisfaction.

264. DURING this ſtay in London, I had more than once the honour of attending the *Board* of *Trinity Houſe* by their deſire, and they were pleaſed to approve of our methods and proceedings. The latter time, which was upon the 2d of June, was to give my opinion upon a propoſal that had been made, and ſtrongly recommended to them by an *Optician* in London, who propoſed to grind all the panes of glaſs for the lantern of the Edyſtone to circular ſegments; ſo that the whole together ſhould form a ſphere of fifteen feet diameter: to this I obſerved, that it was in reality a method of making an *eaſy* thing *difficult* and expenſive, without the leaſt ſolid advantage. For, the propoſer ſeemed to imagine it needful that the rays of light ſhould proceed from the lantern in right lines in every *poſſible* direction; whereas thoſe rays that proceed in an horizontal direction out of the lantern are thoſe *alone* that are ſeen from the ſurface of the ſea by diſtant obſervers; all the reſt either going over their heads into the air, or falling down into the water before they reach them: and as, for the ſufficient ſpreading of the lights, ſo as not to interfere with each other, it had been found needful to place them in *Rings*, at two *different* heights; it would be only that ring of lights which was even with the centre of the ſphere, whoſe rays could proceed perpendicularly through the globular panes; the others above or below, muſt paſs through with a proportional obliquity: whereas the rays proceeding horizontally would paſs through the *upright* ſides of the lantern in a direction equally near the perpendicular, whether the light exhibited was high or low. And for this explanation, which fully convinced the Board of the inutility of the ſcheme, I received the thanks of the *Deputy Maſter*, in the name of the body.

265. HAVING left all neceſſary orders for the works going on in town, I arrived at Plymouth the 22d of June, where I found all the ſtone-work hewn out, the two courſes compoſing the cove and balcony floor upon the platform, with the balcony rails, and the baſe or plinth courſe of the lantern thereon; and every thing in all the forwardneſs I could expect.——I found that on the 13th inſtant ſo violent a ſtorm had happened at Plymouth, that the leaves of the trees and buſhes, on the windward ſide, had been blaſted, to the extent of four and five miles from the ſea; as I ſuppoſed, by the ſalts thereof being impetuouſly driven againſt them. In this ſtorm the Neptune buſs had received ſome damage, but had been got thoroughly repaired, and was then out with the ſeamen, ſtill in ſearch of the moorings.——Five of our beſt hands being grown ſelf-important, demanded an increaſe of wages, without which they would not go

* The ingenious Mr. PRICKETT, to whom the *Iron Foundery* of this kingdom owes much, is ſtill living, and is now maſter of the *Falcon* Iron Foundery, near *Blackfriars* Bridge; which is the very ſpot where the famous Mr. JONES, commonly called GUN JONES, had his foundery, and there caſt the ſmaller work of the railing that incloſes *St. Paul's*, London; for which he had the contract: but the larger parts of that work were caſt by Mr. PRICKETT's father, a relation of Mr. JONES, who had his foundery at the Foreſt of *Dean*, in *Glouceſterſhire*.

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any more off to the Edyſtone. I now judged that as the want of earning a ſufficiency of money could be no *juſt* cauſe, the ſhorteſt way to reſtore peace, unanimity, and preſerve our original ſyſtem, was to diſcharge them; which I accordingly did*.

Mr. JESSOP and the ſeamen having now found by experience, the great advantage in point of ſtrength which ropes of all kinds preſerved by not being hard twiſted; and conceiving that the circumſtance of too hard twiſting, had been the occaſion of the parting of our bridle cable the laſt ſeaſon; petitioned that we might have thirty fathoms made on purpoſe for us, and laid quite pliant; in conſequence of which we might alſo increaſe its ſtrength by a number of yarns, and yet diminiſh its ſtiffneſs. This I readily agreed to, and accordingly a bridle cable was *laid* perfectly pliant, though it was 12½ inches in circumference, that is 2½ inches more than the former.

The old chain before mentioned, which upon the ſtricteſt examination was found very ſound and good in general, and every link of it, that appeared to have ſuffered any material waſte, having been cut out and replaced with new, was now found to contain thirty-two fathoms compleat: a couple of ſuitable mooring anchors, as alſo a proper tranſport buoy, chain and anchor having been provided; all theſe were put on board the buſs; and we now did not want any thing but the new chain from London, which coming by land, we could have the greater certainty of its arrival, which was upon the 2d of July, and it was put on board the buſs the ſame evening†.

266. ON Monday morning July the 3d, at four, I attended the party out with the buſs; but, owing to the uſual uncertainty of calms, wind, and tides, and the ſtill inherent property of our veſſel as a ſlow ſailer; it was not till eight the next morning that we came to an anchor at our mooring ground; yet at three P. M. we had compleated this buſineſs in the way already deſcribed § 126. the weſt anchor lying in ſixteen fathoms water, and the eaſt in fifteen, the rock bearing W. S. W. by the compaſs, diſtance by eſtimation three hundred fathoms. The new chain was our weſtern chain, and the eaſtern joined it at ten fathoms from the ſwivel; in conſequence ſo much could act as a bridle in either direction; and to this was *bent* our new pliant bridle cable.——We then proceeded to lay down our tranſport buoy; but the wind freſhened, and obliged us to deſiſt.

Thurſday the 5th of July the wind being at N. W. and moderate; we this morning laid down the tranſport buoy in ten fathoms water; the rock bearing S. W. by S. by the compaſs, diſtance eighty fathoms; which was compleated at ſix. I then landed on the rock with the men; they proceeded to ſet up the ſhears and windlaſs, while I inſpected the work; and found, according to Mr. JESSOP's repreſentation, every thing perfectly ſound and firm, without the leaſt perceivable alteration ſince we left it; except that the cement uſed the firſt year, now in appearance approached the hardneſs of the moor-ſtone; and that uſed the laſt year of the full hardneſs of Portland. By ten the hoiſting tackle was fixed, and the ſpare hands, that were brought out to help with the mooring, returned to Plymouth; and we now proceeded to ſet the floor, not doubting but to compleat the whole of it this day.——The two remaining pieces of the outmoſt circle, which were left uncompleated laſt year, were ſoon ſet; and we proceeded to haul up the ſtones for the next circle (N° 4.) from the ſtore-room; but inſtead of eight, I had the mortification to find that we had but *ſeven*, and unluckily the boat was gone home.——It was therefore the likelieſt conjecture that the piece of ſtone wanting, had been driven out of the ſtore-room door; and probably by the ſame ſea that had floated the ſtone N° 2. mentioned § 262. from the top of the wall: and that this body of falling water, by making its way through the open ribs of the centre, had waſhed this ſtone out at the door, though it weighed between four and five cwt. I had no doubt but that it was miſſing when Mr. JESSOP made his inſpection in March; for finding thoſe ſtones lying upon the ſtore-room floor, piled up much in the ſame manner as we left them; he had never thought of counting them; not conceiving, but

* The work being now brought to ſuch a period that it could go on with leſs interruption, I propoſed that this year the companies ſhould change only once a fortnight, which would occaſion leſs loſs of time, as well as give more equal opportunities, in having both ſpring and neap tides in the compaſs of each turn.

† This chain was forty fathoms, and weighed 36¼ cwt.

that ſuch kind of weighty materials were very ſafely lodged in that place, the floor of which is nine yards above the top of the rock; and the border of the wall riſing up as a parapet of defence near eight feet higher.——The diſaſter of the loſs of N° 2. being foreknown, was eaſily repaired, by making another from the ſame mould; and which we brought out with us, and landed: the ſhorteſt way therefore to overcome this difficulty, appeared to be to ſend home one of the yawls, with orders, to ſend out a ſimilar piece belonging to the third floor; and we went on with ſetting what we had.

Friday July the 5th, we landed upon the rock at four A. M. and, having a very moderate breeze at N. W. I never ſaw the ſea more quiet about the Edyſtone. We proceeded ſo as to ſet two pieces of N° 2. but could go on no further with this part of the work till the arrival of the ſtone to ſupply the place of that which had been loſt.——We now began to fix up the new ſouth fender pile, which had been waſhed away in the courſe of the winter, though fixed with large iron bolts in the firmeſt manner we could. This was compleated at eleven; we then quitted the rock and retired on board the buſs, the *firſt* time, for *want of work*.——At noon we eſpied the Edyſtone boat about two leagues from us, but the breeze being now from the ſouth, as, it has been obſerved, generally happens in the middle of the day in fine weather, we ſent the remaining yawl well manned to bring out the wanting piece, which arrived this afternoon, and in the evening was ſet, with ſeveral others. On Saturday morning we landed at four, and ſoon ſet the two remaining pieces, which finiſhed the firſt floor. We then cleared away the centre, and ſent it on board the buſs.

267. HITHERTO we had got up our ſtones by firſt landing them into the entry-door from the *rock* ſhears, as we had uſed from the beginning; and after that hoiſted them up the well-hole, by a tackle upon the triangle, by hand; but on finiſhing the vaulted floor over the firſt room, many of the pieces of ſtone of the ſuperſtructure being too large to go through the man-holes in the centre of the floors, I contrived and got prepared an additional pair of ſhears, which being placed upon the top of the work, would of courſe be made to riſe with it. The idea of this kind of ſhears will be formed by inſpecting Plate N° 14. at the third ſtage; which we now ſet up, and applied accordingly. In this way the ſtones were hoiſted from the boats, as high as they could be, upon the rock ſhears; then a tackle depending from the top ſhears juſt mentioned, hooked hold of the pieces, and hoiſted them up to the top, on the outſide; and to facilitate this ſecond ſtage of hoiſting, as the work was gradually becoming higher and higher, and the hoiſting with tackles by *hand* not attended with expedition, (ſee note on § 232.) a temporary windlaſs for working it, was fixed in the ſtore-room, as is ſhewn in the ſame plate.——While thoſe things were fitting up, the Weſton arrived at noon on Saturday the 7th of July; and in little more than an hour, her cargo, conſiſting of twelve pieces of Courſe XXX. of near a ton each, was laid upon the firſt vaulted floor, without fear of, or finding, the leaſt degree of ſettlement, though only finiſhed that morning. For this ſervice we employed three men at the rock windlaſs, and two at the ſtore-room windlaſs. The Weſton had not got out of the Gut, before we experienced a change of weather, the wind beginning to freſhen at N. E.; and ſcarce was the firſt ſtone ſet, before our attending boats became ſo unquiet in lying near the rocks, that we found it adviſable to quit the work; however, having procured ſome ſubſtantial ſhelter, we now ventured to leave our mortar buckets, tools, and looſe materials, ſtowed away in the ſtore-room, which was indeed a great eaſement to us when, in conſequence of bad weather, it became neceſſary to quit the rock. As we had now the wind and tide both againſt us, we had a hard pull with our oars to get on board the buſs; which however we happily effected.

The weather being now attended with the uſual uncertainty, upon Sunday the 8th of July only five pieces of Courſe XXX. were ſet; but having ſtaid till Mr. Jessop and his company were perfectly verſed in the mode of proceeding, I took my paſſage to Plymouth; having firſt eſtabliſhed, that they ſhould quit the work at nights; for the building being now raiſed to a competent height, with ſufficient ſhelter to ſcreen the men at high water, in moderate weather; as the day-light now afforded as many hours as the men could poſſibly hold out to work; and as we had always found one hour in the day to be worth two in the night; it ſeemed no longer neceſſary to work by night, except when the unloading of the veſſels or other particular ſervices ſhould require.

268. VARIOUS

268. VARIOUS weather prevented the out-company from making any great progreſs; however, finding, from accounts, that it would be likely to fall to the lot of RICHARDSON's company to *lead* in the chains of the ſecond floor (he not having done this part of the work before) I determined to accompany them. We ſailed on Tueſday the 17th, and after a bad paſſage arrived at the buſs in the evening, and at low water landed with the company. I found the work at Courſe XXXIII. ſix pieces ſet, and four upon the work, unſet, but which were ſcarcely got out of hand, when the ſwell came on ſo violent, that we found it difficult to get on board our yawls. The remainder of this courſe was ſtill on board the Weſton, which had taken it in on the 14th inſtant.——This evening, between ten and eleven, the Edyſtone boat arrived, having on board a part of the ſecond floor; and brought me a meſſage from Lord EDGECUMBE, that *Prince* EDWARD *Duke* of YORK was deſirous of ſeeing the model of the lighthouſe. However deſirous I might be to gratify the curioſity of his *Royal Highneſs*; it yet ſeemed of ſtill more conſequence, that Mr. RICHARDSON and his company, ſhould ſet right about the work of the ſecond floor; Courſe XXXIII. being the firſt chain courſe thereof.

Wedneſday the 18th of July, betwixt three and four, all hands landed, unloaded the Weſton of her cargo, and ſet the remaining ſix pieces of Courſe XXXIII. and by noon the firſt chain was leaded in. This company having therefore now completed one of the chain courſes; having ſet up the centre laſt year; and learnt the uſe of the new tackle by the ſtones juſt hoiſted, and the whole method of proceeding, I took my paſſage to Plymouth on board the Weſton, and arrived in the evening.

269. THURSDAY the 19th of July I carried the model, drafts, &c. to *Mount Edgecombe*, when the *Duke* of YORK was pleaſed to expreſs great ſatisfaction. I had the honour of dining with, and attending his *Royal Highneſs* after dinner to Mill Bay, where the cove and cornice courſes being together, with the balcony rails, and two courſes of the lantern upon the platform; his *Royal Highneſs* was ſtruck with the great ſtrength and ſolidity of the work; and was much pleaſed with the machinery for facilitating the operations of the work-yard.——Being now at liberty, and wiſhing if poſſible to ſee RICHARDSON's company put together the ſecond floor; that I might not be diſappointed by a calm, in caſe there was not wind to carry out the Aſſiſtant, which was alſo ready, I hired a ſix-oared barge; for which, as it afterwards proved, I had occaſion. We rowed out at half paſt two in the morning, and at ſix I landed upon the rock, finding RICHARDSON and company at work. They had completed the ſecond chain courſe of the ſecond floor, had got up the centre, and one of the boat's cargoes upon it, ready to begin the arch, which was now immediately proceeded with; and the day being quite ſerene, a ſea breeze going round with the ſun, and further cargoes of ſtone for the floor being delivered in due time, all went on without interruption.

270. SATURDAY the 21ſt of July, the morning quite fine, the company landed between three and four, and this forenoon the ſecond floor was finiſhed; ſo that notwithſtanding ſeveral interruptions from weather, a whole room with its vaulted cover was built complete in ſeven days.——The above being effected, the company proceeded in courſe of work; and the entry and ſtore-room doors with their iron work being brought out with the laſt boat, the carpenter proceeded to fit the ſame to place; and I ſet about leading the door hooks into the jambs, the holes for which had been made at the cloſe of laſt ſeaſon; but found they had unluckily forgot to ſend out a quantity of block tin, that I ordered, for the purpoſe of giving the lead a proper hardneſs, to prevent their ſhaking looſe; to make, according to Mr. RUDYERD, a coarſe kind of pewter. This was a diſappointment, as it was one of the operations, the mode of which, I had in view to aſcertain by coming out the laſt time; however, that I might not loſe the opportunity, after ſome conſideration the following expedient occurred to me; I melted down all the pewter plates and diſhes that we could muſter on board the buſs, and mixing them with a proper quantity of lead, it anſwered my purpoſe; and the fixing of four hooks was accordingly accompliſhed. The compoſition I afterwards uſed for leading thoſe in, was one pound of block tin to three pounds of lead.——The hooks were let into the ſtone *Lewis* or dovetail faſhion, and were *keyed* in hot; and, like the cramps and chains,

run

run in with oil; and while hot, the external part of the iron was tarred over. And, having now ſeen this work in the ſituation I intended when I went off, I returned to Plymouth.

271. THE weather being quite fine, and the work going on with every degree of expedition that could be wiſhed, on Thurſday July the 26th, I propoſed to go out in the Aſſiſtant, as I expected to arrive there by the time the third floor was completed. Previous to my departure, the Maſter called upon me, to acquaint me that the ſeaman who belonged to his boat, and was to have laid in it all night, was miſſing this morning: and I dare ſay my reader, after what has been ſaid on this head, will wonder that the occaſion of his abſence could poſſibly have once more happened. Concluding he had been impreſſed, Mr. JESSOP went out with the Maſter, on board the men of war in the Sound, and found him on board one, from whom we ſhould leaſt have expected ſuch a detainer; and whoſe Lieutenant refuſed to deliver him without the Captain's order, who was then on ſhore. I thereupon found myſelf under the neceſſity of waiting perſonally on the Captain, who very politely diſmiſſed him at my requeſt; but this incident, from the turn of tides, prevented my arrival at the rock till ſix o'clock the next morning: when, being Friday the 27th, I found Mr. RICHARDSON had finiſhed Courſe XL. (ſee Plate N° 9.) being the ſecond chain courſe of the third floor; for which he was fixing the centre. Having ſeen this done, and the floor begun; having examined what had been done ſince I was laſt there, and finding all right; I returned in the ſame veſſel to Plymouth; and on Sunday the 29th that floor was completed: ſo that in a courſe of thirteen days two entire rooms with their proper covers were built; and, except ſix pieces of ſtone, all by one company.

Mr. RICHARDSON and company were proceeding with the work, when they were relieved by Mr. JESSOP's company on Monday the 30th; having then compleated two courſes of the fourth room: but this company was leſs ſucceſsful, for on Tueſday the weather came on ſo adverſe as to oblige the Aſſiſtant to quit the tranſport buoy, and to come home with her cargo in.——This day, the 31ſt of July, the copper ball, of two feet two inches diameter, with its neck and air pipes, was perfected at Plymouth.

272. THE weather turning out turbulent, and at beſt uncertain, it was Monday Auguſt the 6th before I thought it neceſſary to go out again: but at this time the cove Courſe XLV. being in hand, which comprehended two circular chains, I landed at ſix in the evening, and found four pieces of this courſe ſet; and this evening we ſet three more; it was not however till ten at night on Wedneſday, that this courſe was got out of hand, by the leading in of its two chains.——This day I was preſented, during a conſiderable part of it, with a *Phænomenon* new to *my* obſervation: we had light breezes at the weſt, and frequently drifts of thick fog, which, as the ſun ſhone out, preſented to us upon the top of the building, a rainbow making an *entire Circle*, except where cut off below us, by the ſhaft of the column.

Thurſday Auguſt the 9th in the morning we ſet up the *elliptical* centre, for ſetting the balcony floor; and the Weſton came into the Gut with her cargo; which, though conſiſting of only ſix pieces of ſtone for that floor; yet the wind coming ſuddenly freſh at eaſt, and the tide riſing, it occaſioned ſuch a ſwell in the Gut that ſhe preſently began to roll gunnel *to*, and while the third piece *was hoiſting*, parted her two *Faſts** to the eaſtern rocks, (ſee Plate N° 14;) ſo that being now left to the mercy of the eaſt ſwell driving her againſt the rocks, ſhe muſt have immediately been torn to pieces, had it not been for the *Fender Piles:* upon this accident I ordered both the windlaſſes to be *laſhed*, the ſtones remaining in ſuſpenſion, and all hands to her aſſiſtance; and happily got her out of the Gut, without other damage than to the upper works of her *Quarter*. When ſhe got to the tranſport buoy, there was ſuch a *cockling* ſea, that ſhe had not rode above half an hour, before the three remaining pieces began to ſhift their places, which obliged her to get under ſail and return to Plymouth.——Having ſeen the firſt ſtone compoſing the arch of the balcony floor got into its place, and having given Mr. JESSOP directions for proceeding, the wind by

* Short cables, or hawſers, for ſteadying or faſtening a veſſel, which are proportioned in ſize to that of the veſſel, and the ſtreſs expected.

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this time was become ſo freſh as to oblige all hands to leave the rock; and I being wanted at Plymouth, to put forward the work of the *Copper* roof of the lantern, I went on board the Edyſtone boat, that waited for me under ſail.——This day the fog frequently came on ſo thick that the veſſels at the tranſport buoy could not be ſeen from the houſe.

273. MONDAY Auguſt the 13th RICHARDSON's company went out; and the next day, finding the work advancing towards a completion of the main column, upon which would come in courſe the ſetting of the balcony rails, I attempted to go out the 15th, but was driven back by ſtreſs of weather: however, on Thurſday Auguſt the 16th, I got out to the buſs, landed with the company, and the Weſton was delivered of her cargo; and now all the heavy pieces belonging to the cornice being got upon the top of the building; and every thing but what would go through the hatchways or *Man-holes* in the centre; the moveable ſhears, that had gone up with us, from the top of the firſt room, were taken down and ſent home.——The interior area of the balcony floor I found completed, and we ſtruck the center from under it. We now proceeded to ſet its outermoſt circle of ſtones, which finiſhed the cap of the main column, ſee Plates N° 9; and N° 11. Fig. 9. being parts of the *Corona* or cornice: and we fitted the windlaſs in the ſtore-room, ſo as to hoiſt the ſtones of the lantern through the hatchways.

Friday Auguſt the 17th the laſt pieces of the *Corona* were ſet, and therewith the main column compleated.——I now examined the perpendicularity of the whole building, by letting fall a plumb-line from the centre of the man-hole in the balcony floor to the centre of the bottom of the well-hole, being 49½ feet; and found it to fall a ſmall matter to the eaſtward of the centre of the well-hole; as near as I could determine it, not more than ⅛th of an inch. I then meaſured the perpendicular heights of the ſeveral parts of the building, and found them as follows:

	Feet.	Inches.
The ſix foundation courſes to the top of the rock — — —	8	4½
The eight courſes to the entry-door — — — —	12	0½
The ten courſes of the well-hole to the ſtore-room floor —	15	2½
The height of the four rooms to the balcony floor — —	34	4½
Height of the main column, containing forty-ſix courſes —	70	0

274. WE now proceeded this day to ſet up and lead in the balcony rails, and completed them; but having no ſtone, we proceeded to make the holes preparatory for hanging the *Ports** for the windows; and having brought out a temporary cover for the man-hole of the balcony floor; I this day applied it to uſe; in conſequence of which, when Mr. RICHARDSON had got the ports hung ſo as to keep the ſea from coming in at the windows, he would be enabled to lodge with his company in the houſe.——The temporary cover of the man-hole was as follows: a ſhort tub of about a foot high was made *without* a bottom; and the ſmaller end of it being fixed as near as poſſible to the man-holes of the floors; it was driven into that of the balcony; and by the time it was driven about four inches; the compliancy of the wood to the ſtone rendered it quite tight; then the reſt of its height, forming a border, and ſtanding about eight inches above the floor, would prevent water from dripping into the rooms through the upper man-hole or hatchway; and having alſo provided another tub, about nine inches deep, having a ſtrong bottom in it, and ſo much more in diameter than the other that it would, when inverted, cover it; this being applied as a cover, would in the greateſt ſtreſs of weather defend the building from the entry of water at the top, and this was the ſame that I intended to have uſed, to make good the joint within the firſt vaulted floor, in

* *Theſe* in a dwelling-houſe would be called window-ſhutters; but as they were here made in the ſtrongeſt manner, with double plank, as the port-holes for ſhips are cloſed; being in like manner intended to reſiſt the violent action of the ſea, are ſtill (as they uſed to be) called *Ports* in this lighthouſe. Properly ſpeaking, I underſtand the openings are the *Ports*, and the ſhutters the *Port-lids*.

eaſe my propoſal of keeping a light the laſt winter, had been approved of, and executed*.——The Edyſtone boat arrived with the firſt courſe of ſtone for the lantern, and was unloaded this evening.

Saturday the 18th of Auguſt, we all landed in the morning at four, and proceeded to ſet the firſt courſe of the lantern; which being in a courſe of work, and having left directions with Mr. RICHARDSON for the remaining part, including the ſtone ſtairs in the well-hole; I returned to Plymouth to expedite the work that was wanted to be done to complete the lantern, and arrived there at noon.

275. AMONGST the numberleſs vexations and diſappointments met with in the courſe of this work, not only from the elements, but from the negligence and inattention of others; it was not one of the leaſt, that the Carrier employed to bring the work of the lantern by *land* from London (for no other reaſon but to obviate the *uncertainty* and diſappointment that might attend the ſea), had, to ſerve his own convenience, left the greateſt part thereof at *Exeter* a week before; and I found it was not yet come the preſent week; which prevented our finiſhing the laſt courſe of ſtone from the platform, that was to receive the iron ſill of the lantern. The *Rabbet* was indeed rough cut in the ſtone, and was a plain piece of work; but, as I had never truſted to any thing *fitting* at the Edyſtone, but what had firſt had its parts brought together at Mill Bay, I did not think it prudent to diſpenſe with this rule, without *abſolute* neceſſity: for, the fitting or adapting the parts of matter together, comes under no calculation in point of time; as, from circumſtances, much time may be required for the purpoſe, when little is expected. This evening however the work of the lantern arrived; which deſirable event greatly alleviated the chagrin I had felt.

Tueſday the 21ſt of Auguſt the iron *Ground Sill* of the lantern, or *Cap Sill* of the wall, was brought to Mill Bay; and was tried and fitted to the LIId courſe, which, being the laſt, was made ready for going to ſea.——This day I thought it proper to write to the *Corporation* of TRINITY HOUSE, to acquaint them with the ſtate of the building, and therein expreſſed my hopes that the lantern would be ſoon completed, if the weather continued moderate, ſo as to be capable of exhibiting a light in its proper place; and the houſe made completely habitable, and proof againſt wind and weather, without the aid of temporary contrivances.

276. THURSDAY the 23d of Auguſt. For ſome time paſt I had employed a copper-ſmith in preparing the copper for the roof, ſo far as he could do it, without having the iron work to which it was to be fitted. The platform therefore being now cleared from all the ſtone-work, the upper ſill of the lantern was put together upon it; as alſo the iron ribs that gave the figure and ſtiffneſs to the plates of the roof; and the copper-ſmiths began to fit the copper roof thereto; ſee Plate N° 12: it being only neceſſary here to ſay, that the plates being of 31lb. to the ſquare foot, and of conſequence ſomewhat ſtubborn; to prevent all uncertainty in forming them at their hips to the proper figure, I choſe them to be *mitre-jointed* at the angles; and this joint being covered with a ſtrip of copper, or *ſaddle-piece*, of about three inches in breadth, it was eaſy to fit it to both plates, and render that eaſy that otherwiſe would have been difficult. This ſaddle-piece was therefore fixed upon the angles with a *double* row of copper nails; and the whole being rivetted together, the cupola, when finiſhed, would become one piece, and water-tight, like a boiler.

Friday Auguſt the 24th we had the welcome news by one of the boats, that this day Mr. RICHARDSON compleated Courſe LII.: ſo that the ſtone-work was now ready for the reception of the metal part of the lantern; and alſo that he was proceeding with the ſtone ſtairs.

277. MONDAY the 27th Mr. RICHARDSON and company arrived from the Edyſtone, and gave account that they had lived in the houſe ever ſince the 23d inſtant, and found it very warm and comfortable; much more ſo than the buſs's *hold* and cabin. That he ſet the laſt ſtone of the lantern, being that making the door-head, on Friday the 24th; and then a part of his hands were employed in fixing and completing

* This was intended as an additional ſecurity, beſides an entire cover or platform of wood, as mentioned § 255.

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the fixture of the iron-work of the window *Ports*, while the other part were ſetting the ſtone ſtairs: and laſtly, that they had put on the cap-ſtone of the ſtair-head, and finiſhed every thing belonging to the maſonry on Sunday evening the 26th of Auguſt. However, when all was done, though all was very quiet within the houſe, they found the ſea ſo unquiet about the rocks, that the yawls could not come alongſide them that evening; and that it was with ſome difficulty they quitted their habitation, and got on board the buſs this morning.

278. THE progreſs we had made this ſeaſon could not fail to animate our further proceedings; for from the 5th of July to the 26th of Auguſt, both incluſive, we had completed twenty-three courſes, including the greateſt part of four vaulted floors, ſix circular chains, and in the whole 470 principal pieces. ——Having brought the work to this deſirable ſtate, the next day I diſmiſſed all our maſons and tinners, except eight of our beſt hands, who being uſed to the place, I kept to aſſiſt the joiners, ſmiths, plumbers, copper-ſmiths, glaziers, painters, &c. whom it was neceſſary to take off before we could make an entire finiſh; and who being new hands unaccuſtomed to the place, I judged would act with more courage, by having ſeaſoned men amongſt them.

279. AFTER this time I was thoroughly employed in forwarding the works of the lantern; but we had very ſoon a change of weather, ſo much for the worſe that though the ſeamen were ordered out the 29th, to try to ſweep for and recover the moorings we had loſt in the courſe of the two preceding years; an hard gale of wind and rain from S. W. coming on, they were obliged to return without attempting any thing.——During this time, however, an opportunity was taken by the ſeamen of landing in the houſe, and of wetting the inſide of the rooms all over with water, which I directed to be done, in order to ſeed and harden the cement, and prevent its drying too haſtily; as it was not like the outſide, ſubject to be afterwards wet by the ſea: but the weather never admitted of any opportunity of ſweeping.

On Tueſday the 4th of September, when the work of the cupola was going briſkly on in the yard, the foreman of the copper-ſmiths was taken ſo ill that he was obliged to leave his work.——This day I received a letter from the Secretary to the TRINITY HOUSE, dated the 1ſt inſtant, acquainting me that the *Corporation* deſired me to inform them of the day I was *certain* a light could be exhibited in the light-houſe, that they might advertiſe the ſame; and that the night I ſhewed the light I ſhould acquaint Mr. SYMONDS, Maſter of the *Floating-Light*, not to exhibit it any longer. To this I anſwered, that though I had met with ſome diſappointments, yet I hoped the lantern and cupola would be ready to carry off that week; and that I ſhould endeavour to complete the whole with the utmoſt expedition; and when ready would acquaint the *Corporation*; and concert a proper ſignal with the Maſter of the floating-light, in caſe acceſs to him ſhould be impracticable. That as the ſeaſon was advancing, and the weather growing more precarious, it might not be in my power *abſolutely* to fix the day I could exhibit a light, till the day itſelf arrived: in which caſe, I ſuppoſed it to be their pleaſure that it ſhould be done, giving the proper notices that they had directed; but if I miſapprehended their directions, I deſired not to be left in doubt.

The next day the ſecond copper-ſmith, with his aſſiſtants, finiſhed the cloſing of the joints at the angles; and, that no time might be loſt (wanting the proper workmen), on the 6th I worked myſelf all day at the cupola, aſſiſting in rivetting on ſixteen angle pieces of iron in the inſide, in the nature of knee timbers of a ſhip, for ſtiffening the plates. When theſe were in part finiſhed, the ſecond copper-ſmith was alſo violently ſeized with a *dry Cholic*, in the ſame manner as the firſt had been. The next day, he being incapable of proceeding with the work; and I very anxious to get what remained to be done at the cupola diſpatched; as it prevented the iron ribs, &c. from being withdrawn from the cupola; I again went to work, along with the third copper-ſmith; and on Saturday the 8th this part of the buſineſs being accompliſhed, the whole iron frame of the lantern was in the afternoon put on board the Weſton ready to go to ſea, whenever the wind and weather would permit; it having been invariably bad ever ſince the firſt inſtant.——As there was now nothing to prevent our proceeding to fix the frame of the lantern in its place but bad weather; nor any thing to prevent the cupola from following it as ſoon as fixed, except the joining of the ball to the neck of the cupola; and finding that the copper-ſmiths who had hitherto ſerved me were

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not likely very ſoon to be effective; I requeſted another brazier of Plymouth, to lend me a journeyman to complete this part of the work. But ſuch is the amazing narrowneſs of mind of ſome perſons, that he poſitively refuſed us, though he owned the man could be of no uſe to him the next day, being Sunday: however, on application to *Commiſſioner* ROGERS, he immediately granted leave for the brazier of the yard to aſſiſt us in that, or any thing elſe we might want. Accordingly, on Sunday evening the cupola was got ready for ſea, its ball being fitted; but the weather ſtill continued ſo very bad, that the *Duke* man of war of eighty guns, having parted her moorings, very providentially drove directly into Mill Bay, and grounded on the ſoft mud; from whence ſhe was, on tide of flood, got off without damage.

280. IT was not till the 12th inſtant that we were able to look out to ſea further than to ſupply the ſeamen on board the buſs with proviſions: in this interim I received Mr. SHUTTLEWOOD the *Secretary*'s letter, in anſwer to mine of the 4th inſtant, informing me, that to remove any doubt which might ariſe, he was directed by the *Corporation* to acquaint me, that I was to fix the day of lighting, ſo as to enable them to give a week's notice by advertiſement; and, that I might be certain of the day, proper perſons were to remain in the houſe upon the rock, after the lighthouſe was finiſhed, to light it on the day appointed.

281. EVERY thing immediately wanted to the completion of the houſe being got ready and put on board two of the boats, together with all neceſſary hands; the morning of Wedneſday, September the 12th, at one o'clock, we weighed anchor, in a thick fog, without a breath of wind; a breeze, however, ſprung up, and we arrived at the buſs at five; but the wind being now freſh at eaſt, neither of the boats could go into the Gut; I therefore took the opportunity of landing in a yawl to inſpect the houſe; and had the ſatisfaction to find, that all the ſtone work had been finiſhed by Mr. RICHARDSON and his company in the manner I had ordered it: but by nine o'clock the wind was grown ſo freſh, and raiſed ſuch a troubleſome ſea, that the boats were obliged to return without being unloaded; and, as nothing could be done without their cargoes, I took the opportunity of returning, to expedite what was wanting to be done on ſhore, leaving the workmen on board the buſs.

September 13th. My copper-ſmiths being ſtill unable to work; this morning Mr. KNIGHTON, the brazier from the *King's Yard*, began to work upon the copper funnels for venting the ſmoke from the kitchen fires. The next day at noon the weather became ſo favourable as to admit the boats to go out, and I arrived in the evening, but ſtill could not land on account of the ground ſwell: however, all the working hands at low water had taken an opportunity of getting into the houſe, with their beds, victuals, &c. as they had been directed to do.

282. SATURDAY September the 15th, between three and four in the morning, the Weſton was got into the Gut, and delivered of her cargo, conſiſting of the pillars, ſaſhes, and frame-work of the lantern; and though the turn of the tide made it impracticable to get the Edyſtone boat into the Gut, yet, as her cargo conſiſted chiefly of the joiners materials, theſe being light, were landed by help of the yawls: and now the workmen being eſtabliſhed in the houſe, along with a great variety of materials, every one went to the occupation allotted; to recount the particulars of which, would be equally unintereſting and tedious.——I gave my principal attention to the eſtabliſhing the frame of the lantern upon a bed of lead, and the ſcrewing of it careſully together; ſeeing that every joint was filled, and ſcrew covered with white lead and oil, ground up thick for paint; and every crevice ſo full, that the bringing the ſcrews *home* made the white lead matter to ooze from every juncture; thereby to exclude all wet and moiſture, and ſo as to prevent the iron-work from ruſting. To this purpoſe I took to my aid ROGER CORNTHWAIT, one of the moſt alert of the maſons; this being in reality, after the parts were fitted together by a ſmith, more the ſubject of maſonry than that of ſmith's work.——The attention of Mr. JESSOP was chiefly confined to the other artificers: and the rooms being ſo much encumbered with materials and ſtores, that there was ſcarcely room for the workmen; he and myſelf, as the weather was now promiſing, went to our former lodging on board the buſs.

283. SUNDAY

283. SUNDAY September the 16th was remarkably fine; ſo that by the evening the whole frame of the lantern was ſcrewed together, and its ground-ſill was reſted upon a bed of lead; which was done in the following manner. The whole frame being ſcrewed together, was raiſed from its bearing upon the ſtone about ¾ths of an inch, by a competent number of iron wedges; and adjuſted by them to an exact perpendicular. Both the ſtone and the iron were taken care to be oiled before they were applied to each other; and one of the eight ſides, having its wedges withdrawn, was run with hot lead; and making a place for it to overflow, as much could be uſed as would competently heat both the iron and ſtone, to bring them to a cloſe bearing with the lead; then on the lead's cooling, as the frame became ſupported on one ſide by the lead, the wedges of a ſecond ſide were withdrawn, and treated in the ſame manner, and ſo ſucceſſively till the whole reſted upon a ſolid baſement of lead. It was not ſuppoſed that the ſucceeding maſs could be ſufficiently heated to re-melt the ends of the parts already leaded, as in the caſe of the chains; but being heated ſo as to bring them to a cloſe contact, this I judged ſufficient, as the lead ſo applied had no other intent but to bear *weight*, and give the frame of the lantern one ſolid uniform bearing.

284. MONDAY the 17th. This morning was alſo exceedingly fine; and the Weſton being in ſight, which was appointed to bring out the cupola, we began to ſet up our ſhears and tackle for hoiſting it. This perhaps may be accounted one of the moſt difficult and hazardous operations of the whole undertaking; not ſo much on account of its weight, being only about 11 cwt. as on account of the great height to which it was to be hoiſted, clear of the building; and ſo as, if poſſible, to avoid ſuch blows as might bruiſe it. It was alſo required to be hoiſted a conſiderable height above the balcony floor; which, though the largeſt baſe we had for the ſhears to ſtand upon, was yet but fourteen feet within the rails, and therefore narrow, in proportion to *their* height. The manner in which this was managed will in a great meaſure appear by the repreſentation thereof in Plate N° 14. (ſee the uppermoſt ſtage); but is more minutely explained in the technical detail of that plate.——As the legs of the ſhears that had been uſed upon the rock would have been in the way of the cupola, they were now removed, as being done with there, and were uſed as a part of this machinery.——About noon the whole of our tackle was in readineſs; and in the afternoon the Weſton was brought into the Gut; and in leſs than *half an hour* her troubleſome cargo was placed upon the top of the lantern without the leaſt damage.——During the whole of this operation, it pleaſed God that not a breath of wind diſcompoſed the ſurface of the water; and there was the leaſt ſwell about the rocks I had obſerved during the ſeaſon.——This work did indeed require good weather, and we had it; or otherwiſe we muſt have poſtponed it, till it had at leaſt *ſeemed* promiſing; but yet we were *prepared* for ſomething otherwiſe than *perfect* tranquillity: for, beſides that our ſhears and tackle were ſo well laſhed down and ſtayed, that it was not a ſmall blaſt of wind that would have carried them away, I had it in contemplation (if it had been needed) to have appointed a couple of men to go up upon the cupola, with ſtaves in their hands, who could, in moderate weather, have defended it from the wall.——This evening the cupola was ſo far got fixed, with its ſcrews, that the tackle was caſt off from it: but this was ſcarcely got done before the wind began to blow freſh at E.

Tueſday September the 18th, in the morning, the wind was at S. E. with intervals of thick fog; however, betwixt thoſe, I had the ſatisfaction, with my teleſcope, to perceive the Edyſtone boat, on board of which I expected the *Ball* to be; and which being *double gilt**, I had ordered the carriage of it to be carefully attended to. The wind and tide were both unfavourable to the veſſel's getting ſoon near us; therefore, being deſirous to get the ball ſcrewed on, before the ſhears and tackle were taken down, one of the yawls was diſpatched to bring it away. This being done, and the ball fixed, the ſhears and tackle were taken down, which took up nearly as much time as was employed in ſetting them up; that is, near twelve hours each, in the whole, to do the work of an hour.——I muſt obſerve, that by choice, I ſcrewed on the ball with my own hands, that in caſe any of the ſcrews had not held quite tight and firm, the circumſtance might not have been *ſlipped over*, without my knowledge; being well aware, that even *this part* would at times come to a conſiderable ſtreſs of wind and ſea; and which could not be replaced without ſome diffi-

* The leaf gold was made on purpoſe, being four times the ordinary thickneſs; beſides which, after the firſt coating of gold was on, a ſecond was laid upon it, with a view to make it as laſting as poſſible; and over all a coat of *Amber Varniſh*.

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culty, in caſe any thing ſhould fail*.——I now looked upon it that we might think ourſelves ſecure of finiſhing the lighthouſe this year.

By this time the joiners had ſet up and completed the three cabin bedſteads, (for their plan, and poſition betwixt the windows, ſee Plate N° 11. Fig. 8.) The houſe being now leſs encumbered, the morning of Wedneſday the 19th, the wind freſh at E. and the weather threatening to cut off the communication between the houſe and the buſs; Mr. JESSOP and I removed our beds and ſtores into the houſe, and took poſſeſſion of two of the cabin beds; which we had no ſooner done, than it blew ſo hard, that the yawl was obliged to leave us, and retreat to the buſs.

285. ON Friday the 21ſt all the copper ſaſh frames were got completely fixed in, and ready for receiving the glaſs. In this work we were ſomewhat retarded; for the carrier that brought down the work of the lantern (beſides diſappointing us in time) having careleſsly laid very heavy things upon the boxes that contained the ſaſh frames; by the continual working of the carriage, two of them had been broken; and though I got them carefully repaired at Plymouth, yet I judged it expedient to order two new ones from London in readineſs, which might at any time be changed for the others, if they happened to fail; but (on account of the late bad weather) theſe new ones coming, ſo as to be ſent out to us before it was neceſſary to put them in, I ſet Mr. JESSOP to drill, ſcrew, and fit the new ones, which occaſioned the loſs of time juſt mentioned. All the ſaſh frames, in like manner as the iron work, were ſcrewed in with white lead and oil; as I judged that the beſt means, not only of preſerving the work, but of keeping out the wet. ——This day the Weſton brought out two glaziers and two copper-ſmiths; they ſpoke with us, but it blew ſo hard a gale that they were obliged to return.——On Saturday the Weſton came out again, and brought only one copper-ſmith, the other having been taken ill of the ſame diſtemper, which was ſaid to be *epidemic*; but the wind was ſtill ſo freſh at E. that there was no landing; they therefore put him and the two glaziers on board the buſs.

286. ON Sunday morning the 23d, the yawl came to the houſe and landed the two glaziers and the copper-ſmith, with their utenſils and materials; the former began to glaze the lantern, and the latter to fit and put up the funnels. This day, with my aſſiſtant the maſon, I began to fix twenty-four iron cramps; that is, three to each rib of the roof, and which were obliged to be fixed after the roof was together; and being fixed inſide, and ſurrounding the ribs, ſerved to key home the plates of the cupola to the ribs. For this purpoſe ſmall wood wedges were uſed, as being more ſupple, elaſtic, and compliant than wedges of metal, and therefore more ſuitable to this particular purpoſe. This day alſo the Edyſtone boat brought out and landed a plumber with his utenſils and materials.——The moſt conſiderable work for the plumber, was the covering the whole balcony floor with thick plates of lead; and which extended from the top of the plinth, or firſt courſe of the baſement of the lantern, quite down to the drip of the *Corona*. They were fitted on ſeparately in ſixteen pieces, and ſoldered together, in place, with ſtrong ribbed joints; and, to prevent the ſea from laying hold of them at the drip, and beating them up, they were turned under about 1½ inch; and being near half an inch thick, I judged them ſufficiently ſtubborn to prevent being unripped: I took care myſelf to put the finiſhing hand, by *batting* them cloſely to the ſtone underneath, by the *gentle blows* of a *ſmall* hammer. In this work the copper-ſmith aſſiſted the plumber.——Though the joints of the balcony were all very carefully filled and pointed up with our cement, which of conſequence would render it *water-tight* in the common acceptation of the word, yet this being a *level* part, the water of the ſea beating up in time of ſtorms, would come down with ſuch violence, and in ſuch quantity, upon it; that, to prevent the poſſibility of the leaſt exudation of moiſture down into the rooms, ariſing either from the calcareous nature of the cement, or any want of cloſeneſs in any part of the upright joints, I judged it

* It may not be amiſs to intimate to thoſe that may in future have occaſion to perform the ſame operation, that the ſcaffold on which this was done, conſiſted of four boards only, well nailed together, at ſuch diſtances as to permit it to be lifted over the ball when done with. It reſted on the cupola, encompaſſing its neck; and ROGER CORNTHWAITE placed himſelf on the oppoſite ſide, upon it, to balance me, while I moved round to fix the ſcrews.

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proper to have this part covered with lead in the manner mentioned, and of ſuch a thickneſs that, when once done, the wear of the feet, &c. ſhould not produce the neceſſity of a renewal in many years.

Thurſday the 27th, the lead work upon the balcony and corona being now entirely finiſhed, and the cupola completely keyed home to the ribs; the ſtraps and bolts were applied at each angle of the lantern, for ſcrewing it down to the floor of the balcony: but the copper-ſmith, who had again begun to work upon the funnel, was taken ill, ſo that he could not proceed; and one of the maſons was taken ill alſo.

287. FRIDAY September the 28th. Since Sunday laſt the works of the lead and glaſs were going on very well, the weather in general having been moderate and dry. This day the joiners finiſhed their work, which conſiſted of the following articles.——Three cabin beds to hold one man each, with three drawers and two lockers in each to hold his ſeparate property, which were fixed in the upper room or chamber. (See plan thereof, Plate N° 11. Fig. 8.) In the kitchen, beſides the fire-place and ſink, were two ſettles with lockers, a dreſſer with drawers, two cupboards, and one platter caſe. (Fig. 7. of the ſame plate ſhews how theſe were diſpoſed.) In the lantern, a ſeat was fixed to encompaſs it all round, the door-way excepted, ſerving equally to ſit upon, or ſtand to ſnuff the candles; and to enable a perſon to look through the loweſt tier of glaſs panes at diſtant objects, without having occaſion to go on the outſide of the lantern into the balcony.——Beſides the above, the joiners had fixed the ten window frames with their ſaſhes; that is, two in the upper ſtore-room, diſpoſed N. and S. and four in each of the rooms above: all which were bedded in putty, and falling into rabbets cut for them in the original formation of the ſtone, they could be at any time removed, and replaced at pleaſure, as they were faſtened in only with two wooden pins above, and two below, driven into holes bored in the ſtone. And it is here to be noted, that though, for fixing up and ſteadying the ſeveral articles in their places, ſomething of faſtenings to the walls were frequently neceſſary; yet, wherever any thing was to be affixed to them, it was never done by driving any thing into the joints, but always by drilling holes with a jumper into the ſolid of the ſtone, deep enough to anſwer the end required; and then, if *iron* plugs or bolts, they were either driven, upon a very gentle taper till they became faſt, or were fixed in with lead; or, as was generally the caſe with the inſide work, holes were bored in the ſolid, and oaken plugs being driven therein, and ſawn off even with the ſurface of the ſtone, iron holdfaſts could be very properly and effectually driven into thoſe wooden plugs, by which means the diſturbing of any part of the cement was avoided.

288. IT is to be obſerved, that in the *preſent* edifice I fixed the *Beds* in the uppermoſt room; and the *Fire-place*, which conſtituted the kitchen, in the room below it; whereas, in the late houſe, the upper room was the kitchen, and the beds (which, as I have underſtood, were upon common bedſteads) were placed in one of the rooms below. The former diſpoſition was doubtleſs adopted, becauſe the funnel for the ſmoke would be the ſhorteſt; but, as I was informed that in moiſt weather, the beds and bedding were generally in a very damp diſagreeable ſtate; I propoſed to remedy this evil, by lengthening the funnel into the room, below the top room, by which means the copper funnel paſſing through the upper room, its ſurface being warmed by the ſmoke and heated air within, would communicate a genial warmth to the upper room through which it paſſed; and, as air when warmed has a natural tendency to aſcend, whenever the copper cover was taken off, that cloſed the man-hole or paſſage from the kitchen to the bed-chamber, (and which, indeed, except at nights, would generally be the caſe) the warm air of the kitchen would aſcend through the bed-chamber, into the lantern, and be vented there by the air-pipes made to diſcharge the hot air and ſmoke from the candles. This diſpoſition has perfectly anſwered the end, as nothing can be more completely dry than the two habitable rooms. Nor are the ſtore-rooms below, ſubject to any moiſture, to the injury of the ſtores, being in reality much drier than thoſe of the former building were ſaid to have been. Indeed this is not to be wondered at, if it be conſidered, that the encompaſſing walls are wholly of moor-ſtone, which is a ſubſtance that does not admit of any humidity into its pores, as wood will do: and there is nothing of *Parget* or plaſter in the whole building; for every ſtone fulfils its place inſide and out; the piece of ſtone that makes the outſide, being worked fair within, makes the inner ſurface of the room; and

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the ſame ſtones that are trod upon, as the floor in the room above, reach through and form the cieling of the room below.

289. THIS afternoon the Edyſtone boat came out, and brought out two cheſts of candles for the lights, and other ſtores. She alſo brought out ſixteen croſs bars for the windows, with a couple of ſmiths to fix them, and which were prepared as far as they could be on ſhore: but as by miſtake they had only made half the number I wanted, the order being for ſixteen *pair*, I found it neceſſary to ſend them home to forge and prepare the reſt, while I proceeded, with ſuch help as I had, to fit thoſe we had got.——This boat was to have brought out a painter, who promiſed to come; but hearing of ſo many being taken ill at the Edyſtone, he refuſed to come off. I therefore ſet one of the maſons to work in painting the outſide of the roof of the cupola. The copper-ſmith and the maſon who had been taken ill yeſterday, continuing unfit for work; they, with the three joiners, and the two ſmiths, returned back to Plymouth this evening, in the Edyſtone boat.

After the boat was gone, and it became ſo dark, that we could not ſee any longer to purſue our occupations, I ordered a charcoal fire to be made in the upper ſtore-room, in one of the iron pots we uſed for melting lead; the intent of which was, that as the croſs bars muſt exactly fit their reſpective places in point of length, anſwerable to the diſtances of the ſcrews wherewith the copper ſaſh frames were ſcrewed to the iron pillars of the lantern, there could only be prepared on ſhore, holes made at one end; leaving the other to be marked to its place. In conſequence, all theſe holes muſt be bored here; and to facilitate this operation, by *annealing* the *blank* ends of all thoſe bars, they were made red hot all together in the charcoal fire. Moſt of the workmen were ſet round the fire, and by way of making ourſelves comfortable, by ſcreening ourſelves and the fire from the wind, the windows were ſhut; and, as well as I remember, the copper cover or hatch put over the man-hole of the floor of the room where the fire was: the hatch above being left open as a funnel for the heated vapour to aſcend. I remember to have looked into the fire attentively, to ſee that the iron was made hot enough, and not over-heated: I alſo remember I felt my head a very little giddy: but the very next thing of which I had any ſenſation or idea, was finding myſelf upon the floor of the room below, half drowned with water. It ſeems, that without being further ſenſible of any thing to give me warning, the *Effluvia* of the charcoal (being from my ſituation more expoſed thereto than the reſt) ſo ſuddenly overcame all ſenſation, that I dropped down upon the floor; and, had not the people hauled me down into the room below, where they did not ſpare for cold water to throw in my face and upon me, I certainly ſhould have expired upon the ſpot.

290. THE next day, *Michaelmas*-day, was diſtinguiſhed by the whole glazing of the lantern being completed; and conſequently now the houſe was in a condition to exhibit a light.——I proceeded with my *Maſon* to bore the holes, and fit the bars; in doing which I found we made ſuch good diſpatch, that I doubted not but we ſhould have them all fixed before we received any more from the ſmith; and this day, not having been diſtinguiſhed by any other event than what is above-mentioned, it may be a proper place to mention what my intention was reſpecting theſe croſs bars.——They were not indeed a part of the original deſign. I had conceived that the main upright ſtandards of caſt-iron (ſee Plates N° 12, 14, and 16.) having their feet or claws ſtrongly ſcrewed down upon their *Ground-ſills* and to their *Cap-ſills*, which were of wrought iron, four inches broad, and almoſt an inch thick; theſe, together with the great number of ſcrews, faſtening the copper ſaſh frames thereto, would form ſo ſtrong a frame, that no power leſs than what would overſet the whole lantern, could make any material derangement of its figure: yet, when I afterwards conſidered, that all the bars, both great and ſmall, were either perpendicular or horizontal, and conſequently nothing to oppoſe the *racking* of the frame; the violent actions of the ſea, though not ſufficient to break any of the parts, yet might be ſubject to produce ſuch kind of twiſting, agitations, and vibrations, as that by preventing the panes of glaſs from being at reſt in the putty, might prevent their fixing therein, with that ſolidity which I wiſhed. For, though underneath the putty in every pane, there were ſix braſs pins, driven through holes drilled acroſs the bars, by way of retaining in the panes excluſive of the putty;

yet

yet to keep them as ſteady as poſſible, from the cauſes of vibration juſt mentioned, I determined to place a pair of *Croſs Bars* behind each ſaſh frame, ſcrewed thereto in a firm manner. In conſequence, each face of the octagon having two ſaſhes in height, the whole number of ſaſhes was ſixteen; and there were thirty-two bars: which, to make little obſtruction to the light, were not only placed ſo as to be the leaſt poſſible in the way, where the candles were commonly to be put, but were at a *medium* leſs than an inch in diameter; being ¼ of an inch near the ends, and 1¼ inch in the middle. Theſe bars have in reality completely anſwered the end intended.——The next day, September the 30th, the glaziers had ſcarcely finiſhed the puttying of all the windows of the rooms below, when the principal one was taken ill; however, he got that part of the work out of hand.

291. MONDAY October the 1ſt I completed the fixing of the firſt eight pairs of croſs bars begun on Saturday; and, leſt weather, or any accident, ſhould prevent the reſt from being fixed, ſo ſoon as intended, I diſpoſed theſe eight pairs ſo as moſt effectually to contribute to the general purpoſe: for this reaſon I fixed them upon the N.E. S.E. S.W. and N.W. faces of the lantern, leaving the intermediate faces without any; by which means their ſtrength became equally diſtributed *.——This day alſo the copper funnel was finiſhed, by the help of the *plumber*; and on being tried by lighting a fire, was found fully to anſwer. The tackle was alſo fixed for raiſing and lowering the *Chandeliers*; and thoſe being hung, (ſee Plate N° 12.) there was now nothing to hinder our making trial by lighting the candles, while it was *day-light*, to ſee that every thing, regarding the light, operated in a proper manner. Accordingly this afternoon we put up twenty-four candles into their proper places, and continued them burning for three hours; during which time we had a very effectual trial; for it had blown a hard gale of wind at S.E. all day, which ſtill continued; and keeping a fire at the ſame time in the kitchen, they both operated together without the leaſt interference; not any degree of ſmoke appearing in the lantern, or any of the rooms: and by opening the vent-holes which I had cauſed to be made at the bottom of the lantern, for occaſional uſe, it could be kept as cool as we pleaſed; whereas, in the late lighthouſe, this uſed to be complained of, as being ſo hot, eſpecially in ſummer, as to give much trouble by the *running* of the candles.

Tueſday October the 2d, the wind freſh at E. the Weſton came out with two perſons to be light-keepers; but, as they could not land, they were put on board the buſs.——Letters brought by the Weſton were delivered in the houſe by means of a *Keg*. This I got made, with an intention to convey proviſions and ſmall ſtores into the houſe, at ſuch times as a boat might come near the rocks but not be able to land. It was made very ſtrong, with one of the heads to take out, and fit like a plug; ſo as to be water-tight when driven in with a piece of canvas. This being carried by the wind and ſea to the leeward of the houſe, could be taken up by a boat in that ſituation: and we found it to anſwer whenever we had occaſion to uſe it. The Weſton alſo brought out eleven more of the croſs bars; which not being able to land, were left on board the buſs; and, as I was deſirous of getting them as ſoon as poſſible, we at low water got a rope from the houſe, by the keg, to the yawl; and to this faſtening the bars, they were ſunk with the keg, and therewith drawn into the houſe.

292. WEDNESDAY October the 3d, we began to fix the *Conductor* for lightning, (§ 158.) As the copper funnel reached through the ball, and from thence came down to the kitchen floor, above forty feet, (ſee Plate N° 9.) I conſidered this as containing ſo much metal, that if ſtruck with lightning, it would thus far be a ſufficient conveyance; then joining the kitchen grate to the leaden ſink by a metal conveyance, the ſink pipe of lead would convey it to the outſide. From the ſink pipe downwards, which being on the N.E. ſide, was conſequently the leaſt ſubject to the ſtroke of the ſea; we continued the *electrical* communication by means of a ſtrap of lead about 1½ inch broad and ⅛ths thick, fixed on the outſide by being nailed to oaken plugs, drove into *two* jumper holes in the ſolid of each courſe; the prominent angles of the ſtrap being *chamfered* off, it was bedded and brought to a ſmooth ſurface with putty. At the foot of the leaden ſtrap, an eye-bolt of iron was driven into the rock; and to this was fixed an iron chain, long

* Was this part of the work to do again, or the like to be wanted, the croſs bars would moſt commodiouſly be caſt as a part of the copper ſaſhes; and are ſo repreſented in Plates 9 and 12. But not intended to interfere with the glaſs panes.

enough to reach at all times into the water; its lower end being left looſe to play therein, and give way to the ſtroke of the waves: by this means an electrical communication was made from the top of the ball to the ſea.——This day we learnt from the buſs, that one of our intended light-keepers, by the rolling of the buſs, had fallen, and put out his ſhoulder; and that the other being intimidated, refuſed to come into the houſe.

293. THURSDAY October the 4th, the wind at N. W. and moderate; the Edyſtone boat came out with ſtores and water, which were landed, as alſo ſome more of the croſs bars.——The ſeaſon being now advanced towards that which we had always found to grow very *precarious*; and every thing being now completed about the houſe that we could judge *eſſentially* neceſſary to the exhibition and maintenance of a light; I immediately agreed with three of the workmen to abide in the houſe, and keep the light till proper perſons could be engaged with and ſent off: I therefore now thought it time to take the opportunity of diſpatching an expreſs by the Edyſtone boat to Plymouth, to be forwarded to the *Corporation* of TRINITY HOUSE, giving notice for Tueſday the 16th of that month, as the day of lighting the houſe; which allowed twelve days for the paſſage of the expreſs, and advertiſements for a week previous, as ordered by the Corporation: and at the ſame time I diſpatched the yawl, with a letter of notice to the ſame purport to *Captain* SYMONDS, Maſter of the *Floating-Light*.——The ſick glazier, and the man with the diſlocated ſhoulder on board the buſs, returned with the boat to Plymouth.

Friday the 5th of October, all the croſs bars were got fixed that we received yeſterday. There being a great ſea about the rocks, with wind at S. W. I could, by reſting ſteadily againſt the wall of the lantern, perceive a ſenſible motion from the action of the ſea. This I did not wonder at, having felt a ſteeple ſenſibly move by the ringing of bells; but I was quite ſurprized to find, that ſuch heavy ſeas as now rolled over the *adjacent* rocks, *without touching* the building, produced a motion nearly as ſenſible. This, however, fully convinced me of what I had for ſome time been led to think, that the Edyſtone rocks have a very ſenſible degree of *Elaſticity*.

Saturday October the 6th, the wind was at S. W. but become very moderate. The ground ſwell, however, that came home, frequently this day broke up as high as the windows of the kitchen, but I could not perceive *that* to produce the leaſt ſenſible motion in the building.——This day the plumber completed every thing in *his* way about the balcony.——At low water the yawl brought the light-keeper who had remained on board the buſs; and who having in ſome degree conquered his fears, made an apology for not coming before, which I thought it prudent to admit of.

Sunday October the 7th. After ſo ſevere a viſitation of ſickneſs amongſt the workmen *, all thoſe remaining in the houſe, that ſtood their ſervice, were employed in clearing the rooms ready to take in the winter's ſtores: except thoſe who were employed in giving the outſide parts the *ſecond Coat* of paint, ſince being fixed in place.——This day the electrical communication for the lightning was completed.

294. MONDAY October the 8th in the morning, the Weſton arrived at the tranſport buoy; being loaded with further ſtores for the winter; and had the remainder of the croſs bars on board: theſe were immediately landed with the yawl; but the ground ſwell was too great to admit the boat to venture into the Gut; and the Edyſtone boat appearing in ſight, which was alſo laden with ſtores, ſhe was ordered to deliver them on board the buſs. This being done, and it appearing doubtful when the Weſton might be able to deliver her cargo in the Gut, ſhe was ordered to follow the ſame example. As ſoon therefore as the tide was fallen away ſufficiently, to render it practicable for the yawls to come into the Gut, a number of hands were employed to bring the ſtores from the buſs, and land them in the houſe; and in the courſe of this tide the whole buſineſs was performed, four caſks of water only excepted.——This evening the ſecond coat of paint was finiſhed, and the croſs bars all completely fixed. A time-piece I had provided, was ſet up and put in motion †; and as nothing material now remained to be done, we determined, as the

* There were now but few remaining hearty; of this number, however, were Mr. JESSOP and myſelf.

† A dial for the regulating of the clock, would naturally ariſe from obſerving when the ſun-beams of the ſouth windows, directly tended to the oppoſite ones; as this would point out the time of noon. This Time-piece, by a ſimple contrivance, being made to ſtrike a ſingle blow every half hour, would thereby warn the keepers to ſnuff the candles.

wind

wind and weather were then favourable for unmooring the buſs, to leave the houſe in poſſeſſion of the perſons appointed to keep the light, and remove on board the buſs the firſt opportunity: and, leſt time ſhould be ſhort on our removal, and another opportunity might not occur before the day of lighting; this evening, with the aſſiſtance of Mr. JESSOP, I gave full orders and inſtructions to HENRY EDWARDS and JOHN MICHELL both tinners; and who were the only perſons that had continued ſteadily to act as *labourers* from the beginning. Thoſe, therefore, being perſons upon whom I could depend; and who had ſeen and aſſiſted in the lighting of the houſe in the day time the 1ſt inſtant, I could have no doubt but that they would fully inſtruct the perſon entered as *Light-keeper*; and that my directions would be punctually obſerved, and the houſe lighted according to its deſtination the 16th inſtant; in caſe I could not myſelf be preſent, as I propoſed to be, if wind and weather permitted.

295. TUESDAY the 9th of October, in the morning, before one o'clock, the yawl came into the Gut with the remaining caſks of water, and began to remove the men, with their beds, tools, and neceſſaries; which being performed, Mr. JESSOP and myſelf, with all hands, were got on board the buſs at four.——The wind was then S. E. and very moderate, the ſky ſerene, and every thing appearing promiſing, we began to unmoor. We had ſcarcely got the eaſtern anchor from the ground, when clouds began to gather from the S. W. and the wind ſhifting into that quarter, threatened an immediate ſtorm: however, as my maxim always was, *to proceed till there was ſomething to ſtop us*, we went on; and fortunately, though it looked very diſmal and threatening all the time, it did not blow outright; and the more diſmal it looked, the more anxious we were to get out of the way of it.——In heaving up our moorings we were much ſurprized to find the eaſtern chain *parted* from the weſtern; but by applying to the buoy of the weſtern anchor it was got on board; and in heaving in the bridle, we found one of the links more than half worn through, by fretting againſt the rocks; it being as bright as if ſhorn by a file; ſo that in all probability the next hard gale of wind muſt have broke the buſs adrift.——At four in the afternoon having got all our moorings on board, we hoiſted ſail; and it now coming on a freſh gale of wind at S. W. it drove us right into the Sound; and the tide being alſo in our favour, we never had ſo quick a paſſage in the *Neptune Buſs*; for in leſs than *three* hours, we were come to an anchor in *Plymouth Harbour*, with a flowing tide, to the great joy and ſatisfaction of all concerned.——And thus, after innumerable difficulties and dangers, was a happy period put to this undertaking, without the loſs of *Life* or *Limb*, to any one concerned in it; or accident, by which the work could be ſaid to be *materially* retarded.

CHAP. IV.

Comprehending an Account of OCCURRENCES, *ſubſequent to the bringing Home the* NEPTUNE BUSS *at the End of the Seaſon* 1759, *to the preſent Time.*

296. IT perhaps will not be thought the leaſt commendation to the ſtructure of the Edyſtone Lighthouſe, that this will not be one of the *longeſt* chapters in the whole work. In reality, very few occurrences have happened regarding it in the whole of this interval; and I truſt it will be thought the very beſt part of the account, that in the courſe of *thirty* years, that have elapſed ſince the commencement of this chapter, it ſtill remains in the ſame good condition, in which it then was: however, it may be proper, herein to take notice of ſeveral matters, that did not naturally fall into the courſe of the preceding narrative.

The very evening after we got in with the buſs, it began to be very bad weather from the S. W. and which continued till Monday the 15th; ſo that had we not got clear of the houſe, and unmoored when we did, in all likelihood we muſt have ſtaid there till then.

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As Monday 15th proved more moderate, preparations were made, and every thing got ready to go out the next morning, in order to be preſent at the lighting of the houſe; but that morning it again began to blow at S. W. to a degree which rendered the attempt needleſs; and the night appointed for the lighting was ſtormy; which weather continued till Thurſday the 18th, when preparations were again made to go out, and all ſtores were got on board.

297. FRIDAY October 19th. This morning appearing promiſing, though little wind, I went on board with Mr. JESSOP, ROGER CORNTHWAITE the maſon, (whoſe particular activity in this building, I have had reaſon to notice and commend) JOHN WATT, painter and glazier, and JOHN HATHERLEY. This laſt I had agreed with to go out as light-keeper, upon the old eſtabliſhment, inſtead of JOHN MICHELL, tinner, who only entered till one could be got. We went out in the Weſton, being accompanied by the Edyſtone boat, as being the ſmalleſt and the lighteſt; and therefore the moſt eaſily managed in the Gut. ——We had all our ſeamen, and alſo one of the yawls attending. About noon, having had but little wind, we got to the tranſport buoy; which we had not unmoored, intending to leave it to ride as long as it could, as it might be of ſervice in the attendance upon the houſe during the ſucceeding winter.——As it was then about half flood; that is, about the turn of the tide toward the eaſt, we did not think it prudent to attempt to lay either of the boats alongſide the rocks, but landed in the yawl, and had the ſatisfaction to find *all well.*——HENRY EDWARDS gave account that they lighted the houſe, as they were directed, early on Tueſday evening the 16th, and had continued the ſame the two following evenings; and that they found the lights to burn very ſteadily, notwithſtanding it blowed very hard, eſpecially on the night of lighting.——That they had the greateſt ſeas on Friday, Saturday, and Sunday, preceding the lighting; and that then the waves broke up ſo high, that had they not been thrown off by the *cove courſe*, they would have endangered the breaking the glaſs of the lantern: but that, notwithſtanding the broken ſea went in great quantities over the ball, yet no water came into the lantern by the funnel, the air-pipes, or otherwiſe; except that a very ſmall leakage came in, by an upright joint in the ſtone-work of the lantern, which they ſhewed us, and which we eaſily remedied.——They informed us, that the ſeas had broke up, during almoſt the whole time of our abſence, ſo high upon the houſe, that they were not only obliged to keep the *ports* of the windows ſhut to windward, but alſo to keep the joints well ſtuffed with *oakum*; for otherwiſe, the great preſſure of the water made its way through the joints thereof, even of the *uppermoſt* chamber. That however, upon the whole, they had been both warm and dry. They further informed us, that when the ſeas broke up the higheſt, they had experienced a ſenſible motion, ſomething like what we had all obſerved from the hole in the rock, in hard gales of wind at E.; but that being but juſt ſenſible thereof, it occaſioned to them neither fear nor ſurprize.

This afternoon we landed a further ſupply of coals, water, and ſmall ſtores, by means of the yawl, which completed the intended winter's proviſion for ſix months*.——On this occaſion I ſhall take the opportunity to obſerve, as intimated § 58. the wages of the light-keepers had, for many years paſt, been eſtabliſhed at £. 25 per annum, finding their own proviſions of *eating* and *drinking*.——I found it a matter of complaint through the country, on my firſt going down to Plymouth, that the light-keepers had at various times been reduced to the neceſſity of *eating the Candles*; and therefore, it ſeemed very much to be wiſhed, on lighting the new houſe, that ſome ſcheme might be hit upon, whereby the neceſſity of ſuch ſhocking viands might be avoided; and the remedy, with the greateſt part of the obſervers, ſeemed mighty eaſy; "Let them have greater wages, whereby they may be enabled to buy a better ſtock of proviſions:" or, "Let the proprietors furniſh them with victuals."——On conſidering this matter over and over, it did

* Account of Stores laid into the Edyſtone Lighthouſe, in October, 1759, by the Proprietors, as a *Winter's Stock.*

Coals, in ½ hogſhead caſks — —	64 buſhels.	Large candles — — —	16 cheſts.
Water, in ditto — — —	N° 16	Small ditto — — —	1 ditto.
Lamp oil, in ditto — — —	N° 2	Biſcuit — — —	3 cwt.
Salted beef — — —	2 cwt.	Boiling peaſe — — —	2 buſhels.
—— pork — — —	1 ditto.	Oatmeal — — — —	2 ditto.

N. B. The above is according to Wincheſter meaſure; but the cuſtom of dry meaſure at Plymouth, is denominated according to *double Wincheſter*; that is, the double of *Wincheſter*.

not

not appear that either of theſe expedients would anſwer the end. £. 25 *per annum* ſeemed to many a very bare ſubſiſtence; but yet, being near upon 10*s.* a week, it was conſiderably more than the country price of labourer's wages, as I found it. A labourer on ſhore has houſe rent to pay, houſhold goods to provide, and maintain, as alſo fire and candle. In *this* ſituation, he is at *no* expence, but merely meat and drink, and a few cloaths; of which he is not in need of many changes: it is plain, therefore, that it was not want of ſufficient wages that cauſed the complaint, but want of ſufficient foreſight. I have given many inſtances, in my narrative of the progreſs of the building, that the high wages we were obliged to give, to induce *ſtout* labourers to face the perils of the ſervice, did not engage them to ſecure themſelves with a ſufficient ſtock of proviſions. Even for thoſe ſhort intervals they were likely occaſionally to ſtay, their ſea ſtock was ſo ſlender that they were repeatedly obliged to come home, *after ſharing their laſt pound of bread.*——Nor did it appear that things would go better if the *Proprietors* were to provide ſuſtenance for the light-keepers: for, on enquiry of the moſt elderly people, I underſtood, that formerly, as ſeems intimated by WINSTANLEY, the houſe was provided by the proprietors*. By degrees the light-keepers got into the practice of embezzling the ſtores, and bartering them for ſtrong liquors, then alledging that they grew bad, and that they were obliged to throw them into the ſea; ſo that the eating of the candles was an early complaint; and which at that time ſeemed likely to be obviated by allowing them wages to victual themſelves, as had ever ſince continued.——The moſt likely expedient therefore that occurred to me, was, for the proprietors to put into the houſe a ſtock of *Sea Proviſions* ſufficient to laſt three men for ſix months; which ſtock of proviſions being the property of the proprietors, the light-keepers were to provide for themſelves as *they liked*; the boat being to attend them as before: this ſtock of proviſions being only lodged there, by way of ſecuring them from ſtarving.——Of this they might take what they had occaſion for, being accountable only for what was wanting, at the ſeaſon when the ſtock ſhould be overhauled. In this way there could be no *want*, or foundation of complaint of *badneſs* of the proviſion; nor yet any *embezzlement* of the ſtore: and provided it was laid in of the beſt kind, and the men only charged with what was conſumed, at the *wholeſale* price, it would come to them ſo much cheaper than any victuals they could provide, that it would be greatly their intereſt to uſe it; as it would enable them to live conſiderably cheaper in reſpect to ſuſtenance, than they could poſſibly do on ſhore. In effect, none would remain unconſumed, or be any loſs to the proprietors, unleſs ſome of it ſhould turn out *really* bad; which would be a trifle to them, as it would ſeldom happen.——This being propoſed to the proprietors was readily agred to; and in this view the ſtock of proviſions, already ſpecified in the note to this ſection, was laid into the houſe; and was found fully to anſwer: and, the light-keepers being at liberty to get a joint of *freſh Mutton*, or piece of *Beef*, or a caſk of *Ale*, whenever opportunity admitted, and they *chooſe*, all diſſatisfaction about the proviſions was totally prevented.——In this way matters went on for ſeveral years, till at length, by the aſſiduity of JOHN BOWDEN, they found themſelves ſo frequently enabled to get *freſh Proviſions*, and the light-keepers *ſeldom changing*, that they chiefly depended thereon; laying in themſelves a ſmall ſea ſtock of ſalt proviſions, to be uſed on emergencies; inſomuch that the agent became no longer troubled in providing for them.

298. IN this viſit of the light-houſe we began to give the outſide faces of the upright pillars of the lantern a coat of paint, of a *lead colour*, the ſame as the *Cupola*, and *Balcony* rails, had originally been done.——Theſe uprights being before painted white, the ſame as the ſaſh frames; I had obſerved, on firſt ſeeing them at a diſtance, on our paſſage home on the 9th inſtant, they produced an unpleaſing effect: for theſe pillars inſtead of appearing *more* conſpicuous, by reaſon of their *white* colour, in reality appeared *not at all:* for, being of the colour of the ſky, not forming a ſufficient contraſt with the light ſeen through the glaſs, the *Cupola* appeared *unſupported*; like an *Umbrella* at a diſtance.——This circumſtance I find particularly noted in my Journal; to the intent, that any one hereafter, who ſhould in like manner think to improve the colouring of the lantern, might not fall into the ſame error that I had done.——We had however ſcarcely finiſhed one of the faces before a ſtorm of hail came on at N. W. which prevented our proceeding; and alſo cut off all communication with the veſſels. Upon this we began to give the

* "But by good providence, then two boats came with *proviſions*, and the *family* that was to take care of the light; and ſo ended this "year's work." § 20.

inſide of the cupola another coat of paint, as this could not well be repeated next ſeaſon, on account of the coat of ſoot, that long before that time it would acquire; and perhaps prevent an adheſion with the former coat. This evening our two *hands* worked therein for three hours after the candles were lighted, yet ſo perfect was the ventilation, that though their work was principally in the roof above the candles; they did not experience the leaſt inconvenience from ſmoke.——This afternoon the floating-light veſſel ſailed from her moorings, and coming near the rock, gave us *three Cheers*, which we very heartily returned. ——This evening Mr. JESSOP and myſelf exerciſed all the light-keepers in their turns to trim and ſnuff the candles, and render them perfect therein: for, however eaſy and trifling ſuch a buſineſs may ſeem, there are circumſtances, which neglected, the effect of the light would be greatly impaired*.——This night I took up my lodging in one of the cabin beds, and found as I had done before, that when all was ſhut in, and otherwiſe quiet, the noiſe of the ſea breaking upon the rocks made it ſeem as if there was a violent ſtorm: and being now more ſtill than before I had uſed to be, from having fewer workmen; I had perſuaded myſelf before morning, that it really was ſo. I was therefore ſurprized, on getting up, to find that the ſea was more quiet than it had been the preceding evening.

Saturday October 20th. This morning being fine and dry, we finiſhed the outſide painting; and alſo fixed an iron hand-rail to render the paſſage more ſafe and eaſy from the ſteps cut in the rock to the foot of the ladder, ſee Plate N° 8: and *laſtly*, our maſon ended thoſe rough ſteps.——As every thing was now done, that a further time would have induced me to do; the laying on a coat of *Amber Varniſh* over the whole painted work, excepted; which the ſeaſon would not admit of, on account of the coats of paint not being ſufficiently hardened; and as the general care and ſuperintendance of the building was to be committed to Mr. JESSOP, I had no difficulty in leaving this matter to him to be done the next ſpring. Having therefore read over and explained the *Inſtructions* I had received from the proprietors, for the light-keepers, fairly ingroſſed; and hung the ſame up in a frame for their guidance; and alſo given every inſtruction I could think of, and every exhortation that I could deviſe, to a diligent diſcharge of their duty, I took my leave of the building and of the light-keepers; who were HENRY EDWARDS, HENRY CARTER, and JOHN HATHERLEY.

299. AT noon we went on board the boats and ſailed; but the wind being northerly, and not ſo freſh as we could have wiſhed it, we were full twelve hours turning to windward upon our paſſage; ſo that it was Sunday morning, October 21, before we arrived at Plymouth.——During this paſſage the air was remarkable clear: and we were about ſeven or eight miles diſtant from the houſe at the firſt lighting this evening. The light at firſt appeared very ſtrong and bright to the naked eye, much like a ſtar of the firſt magnitude. Its luſtre diminiſhed as we increaſed our diſtance, till it came down to a ſtar of about the third magnitude; after this it ceaſed to diminiſh, and on the contrary ſeemed to *increaſe*; this I could not but wonder at: however, at length it became a matter quite out of doubt, as to the fact, it being obvious to the whole company. We ſaw it in this manner till we were paſſed the anchoring place of the men of war in the Sound, that is, near the iſland of *St. Nicholas*, where having ceaſed looking at it for a ſmall ſpace of time, on renewing our look out, it had now totally diſappeared.——Though this was a *Phenomenon* I did not expect, yet I had caſually made an obſervation, ſome time before this was apparent, that led me to a ready explication of it. I obſerved, that while the light was diminiſhing with the diſtance, and yet had a *ſenſible* elevation above the horizon, a kind of luminous appearance was ſeen upon the ſurface of the ſea, directly under the ſtar-like appearance of the light; and though the ſurface of the water was very far from that of a plain *Mirror*, yet, as the top of every wave would appear to be tipped with light, in that very oblique direction, they would all become nearly united in the obſerver's eye. Now when the *elevation* of the object becomes too ſmall to be diſcerned, as ſeparated from the luminous reflection, this will become united with the direct light, ſo that they will appear *as one*; and in conſequence increaſe, till their union becomes perfect; but in going a little further on, till the main light is intercepted by the ſea; that is, till it is in reality ſunk below the apparent horizon, then both the direct and reflected light will be intercepted, and vaniſh together.

* This would be the caſe, if they ſhould neglect to put the *Chandeliers* to their due height; by the interpoſition of the horizontal bars.

300. DURING

300. DURING my ſtay at Plymouth, which was not above a fortnight longer, (that is, till the accounts of different tradeſmen were ſettled) I generally viſited the *Hoa* every clear evening, being curious to obſerve what appearance the light made from thence. It was a fact univerſally agreed in, that the light in the old Lighthouſe had *never* been diſcerned from thence: whatever appearance therefore it now made, was at leaſt ſo much gained by the different fabric of the lantern; the candles themſelves, their diſpoſition, and number being the ſame as before*. I found it required the air to be clear to ſee it at all, and then it appeared like a ſtar of the fourth magnitude; but when the air was very clear, it appeared as a ſtar of the third magnitude, and doubtleſs could have been ſeen ſeveral miles further: and, as it has been ſhewn, that under favourable circumſtances of the *Luminous reflection*, the light may be ſeen at ſea much ſtronger, it is probable alſo at a greater diſtance, than it can from a *great* elevation at land.

301. IN the times of ſtormy weather, that happened during this interval at Plymouth, I took ſeveral opportunities of viewing the Lighthouſe with my teleſcope† from the *Hoa*, and alſo from the *Garriſon*, both of which places are ſufficiently elevated to ſee the baſe of the building and the whole of the rock at low water in clear weather: and though I had had many occaſions of viewing the unfiniſhed building, when buried in the waves, in a ſtorm at S. W.; yet never having before had a view of it under this circumſtance, in its finiſhed ſtate, I was aſtoniſhed to find that the account given by Mr. WINSTANLEY did not appear to be at all exaggerated. (See § 19.)——At intervals of a minute, and ſometimes two or three; I ſuppoſe when a combination happens to produce one overgrown wave‡, it would ſtrike the rock and the building conjointly, and fly up in a white column, enwrapping it like a *ſheet*, riſing at leaſt to double the height of the houſe, and totally intercepting it from the ſight; and this appearance being momentary, both as to its riſing and falling, one was enabled to judge of the comparative height very nearly, by the comparative ſpaces alternately occupied by the houſe, and by the column of water, in the *field* of the teleſcope. ——Of this column, I made an eye-ſketch at the time: and muſt further obſerve, that while I was in the Lighthouſe, during the laſt interval of finiſhing, in which time we had more than one hard gale that obliged us to ſhut the windward ports of the uppermoſt rooms; I particularly noticed the manner in which the waves begun to *gather*, as ſoon as they came ſo near the houſe as to be ſenſible of the ſloping rocks underneath them, (ſee § 6.) Thoſe waves by degrees towering higher as they came nearer, formed a deep hollow ſea at the foot of the building; and then falling into it, ſtruck it with all imaginable fury. Combining this appearance with what I ſaw on ſhore, I have endeavoured to give the reader ſome ſort of idea thereof by the figure in the *Frontiſpiece*.——All repreſentative drawings, however, though from an accompliſhed pencil, muſt be inadequate to this ſubject. The exhibition being *momentary*, and the building for that moment *entirely hid*; the relation betwixt the column and the building, the principal thing deſired, could not have been expreſſed if ſo repreſented; and thinning away the column on one ſide, as here done, ſo as to let the building appear, takes off from the magnitude of the column; and in a *drawing*, its appearance being *permanent*, it ſo nearly coincides with that of a *Jet d'eau*, that it will neceſſarily ſuggeſt this idea, better than what it is intended to repreſent: I muſt therefore refer ſuch of my readers, as may happen to have the opportunity, to ſatisfy themſelves, by taking a view of it from the *Garriſon* or *Hoa* with a good *Teleſcope*, as ſoon after a ſtorm at S. W. as the air comes tolerably clear, but not later than the day following §.

* *Viz.* 24 candles at once, whereof 5 made 2lb.; and they were ſnuffed every half hour. See Note to § 60.——I take this opportunity of mentioning, that the *Lamp Oil* ſpecified in note * to § 297, was an article never provided before. As it will keep good much longer than candles, it was intended to remedy the poſſibility of the want thereof. There were therefore twenty-four *Lamps* made to go into the *Chandeliers*, in place of the *Candle ſockets*: but as the burning of the lamps was found to produce a greater *Soot* upon the inſide of the glaſſes, than candles, though no apparent ſmoke attended either, the lamps were never uſed but in caſes of a neceſſity.

† This glaſs was originally fitted up for me in 1756, by Mr. JOHN DOLLOND, in his beſt manner at that time, with a common double convex object glaſs; but when I came to town the latter end of the year 1757, he fitted it with an *Acromatic* object glaſs.

‡ This is what I ſuppoſe the vulgar attribute to the TENTH WAVE.

§ This momentary *Spout* of the Edyſtone may perhaps be beſt compared with the momentary *jet* of *boiling water*, ſaid to be 19 feet diameter in the orifice, and at times to riſe 92 feet high, thrown from the Fountain *Geiſſer* in *Iceland!* deſcribed in VON TROIL's Letters, Engliſh Edition, page 259—261. To this account, however, I own I could have given but little credit, had it not been confirmed to me by my honoured friends Sir JOSEPH BANKS, the late Dr. SOLANDER, and Dr. LIND, who were eye-witneſſes of it.

Occurrences after leaving Plymouth.

302. THE year 1759 concluded with a ſeries of very ſtormy weather; and it was not till the month of January ſucceeding, that there was any proſpect of the boat's going off. I have a letter from Mr. JESSOP, dated Plymouth 13th January, 1760; in which he mentions, that upon the 8th inſtant the Edyſtone boat went off, wind at E. and moderate, but a great ſwell. They got thither at four o'clock in the afternoon, but could not land. However, going to the weſt ſide of the houſe, they conveyed ſome *ſmall* ſtores into it by means of the *keg* (ſee § 291); and by it received a letter from HENRY EDWARDS, directed to Mr. JESSOP. The purport of it was to acquaint him, that they had had ſuch very bad weather, that the ſea frequently ran over the houſe, ſo that for twelve days together they could not open the door of the lantern, or any other.——He ſays " the houſe did ſhake as if a man had been up in a great tree. The *old* " *men* were almoſt frighted out of their lives, wiſhing they had never ſeen the place, and curſing thoſe that " firſt perſuaded them to go there. The fear ſeized them in the back, but rubbing them with oil of tur- " pentine gave them relief." He further mentioned, that upon the 5th December at night they had a very great ſtorm; the wind being at E. ſo that the ladder which was laſhed below the entry-door broke looſe, and was waſhed away. Alſo upon the 13th there was ſo violent a ſtorm of wind, that he thought the houſe would overſet: and at midnight the ſea broke one pane of glaſs on the S. E. ſide of the lantern*. That they had had a very melancholy time of it; having had beſides, a great deal of thunder and lightning.

Mr. JESSOP further informed me, that upon the 10th the boat went out again; but the wind at eaſt blowed too freſh for her to be gotten into the Gut; that with ſome difficulty they landed ſome freſh proviſions by means of the ſmall boat; the candles, water, and beer, they could not land; but as there were ſeveral cheſts of candles, of the original ſtore, remaining, and a ſufficient quantity of water, there could be no real want for ſome time.——Mr. JESSOP, however, did not give entire credit to what EDWARDS had related in regard to the houſe having ſo great a motion; as SMART and BOWDEN told him, that they could not ſee that the mortar in the joints had *ſtarted.*

303. A LETTER from Mr. JESSOP of the 13th February following, relates that upon the 8th the Edyſtone boat went off to the houſe, and landed four cheſts of candles, and an half hogſhead of beer. That J. BOWDEN told him he went all over the houſe, to ſee if it had received any damage by the ſtorms, but found nothing amiſs; the pane of glaſs mentioned by EDWARDS excepted. In ſhort, he found all in order, the houſe clean, and the people well. The ſouth pile was gone, but the north one remained firm. (See Plate N° 14.)

304. SOON after this a *violent* ſtorm happened at S. W. I was informed that *Admiral* BOSCAWEN had mentioned to the *Admiralty*, that it was the greateſt ſtorm that had been known, by the oldeſt perſon on board his ſhip. I therefore expected a ſtill more formidable account from Mr. JESSOP of its effects upon the Lighthouſe. But no account being received in courſe of the poſt, I wrote to him the 21ſt of that month, deſiring that, as ſoon as poſſible, enquiry might be made into the ſtate of the houſe; as likewiſe whether it has more motion, with the wind at E. or at S. W.; and whether they were ſenſible of the ſea's ſtriking the cornice.——To this I received an anſwer, March 2d, that SMART and BOWDEN had been off the 29th of February, to land ſtores; that they ſtayed at the houſe two hours, and viewed it all over carefully, inſide and out; but could not diſcover any of the mortar ſtarted, nor the joints anyways cracked: and that all the damage ſuſtained by the *laſt* ſtorm was, that the *electrical* ſtrap, which went from the ſink-pipe down to the rock, was waſhed away (ſee § 292.) The glaſs of the lantern was all ſound; the pane excepted that was before mentioned. HENRY EDWARDS ſaid the ſea went all over the houſe, which cauſed a motion much the ſame as when the wind was at E. and he could perceive no

* A number of boards cut to the ſize, had been provided; which might be put in from the *inſide* in caſe of ſuch accident, till a proper repair with glaſs could be made: as had been uſual in former times.

difference

difference when it ſtruck the cornice, or otherwiſe. The light-keepers, it ſeems, had now pretty well got rid of their fears; as they were all well, and made no complaint.

305. EVERY thing now appearing to go on ſucceſsfully and in courſe, I heard nothing more concerning the Lighthouſe till the 8th June, 1761, of which date I received a letter in *Yorkſhire* from Mr. WESTON. In this interval my faithful aſſiſtant Mr. JESSOP had departed this life, leaving an unblemiſhed character behind him; and Mr. RICHARDSON had been appointed *Surveyor* of the Lighthouſe in his ſtead. Mr. WESTON deſired to be adviſed, concerning the renewal of the painting, and alſo reſpecting the reſtoration of the *Electrical* ſtrap; both of which remained undone.——In anſwer, I recommended that the painting ſhould be done by a proper painter; and not by the light-keepers, as he had ſuggeſted: and that the original colours ſhould be preſerved.——That with regard to the *Conductor* for the *Lightning*; as in our hurry in finiſhing, we had not had time to form a *groove* in the wall, wherein to bury the leaden ſtrap, as originally intended; we contented ourſelves with *two* faſtenings at every courſe, as mentioned § 292; the want of which groove, had doubtleſs been the occaſion of its being waſhed away from the wall. However, to render it now ſtill more effectual, I recommended a ſmall round bar of copper, or braſs, of about half an inch diameter, to be formed; and to bury it in a groove made by the point of a pick, fixing it with ſmall copper ſtaples at every courſe, to the plugs that had been uſed for fixing the lead. This bar to be bedded in putty, and covered with the ſame, ſo as to make all fair and fluſh.

306. THE ſtorms which the building had now ſuſtained, without material damage, convinced us, and every one, of the ſtability of the *Stone-Lighthouſe*; except thoſe (who were not a few) that had taken the notion, that nothing but WOOD could reſiſt the ſea upon the Edyſtone Rocks; who ſaid, that though they allowed it was built *very ſtrong*, yet if ſuch a ſtorm as had deſtroyed WINSTANLEY's *Lighthouſe*, was again to happen, they doubted not but it *muſt* ſhare the ſame fate.

The year 1762 was uſhered in with ſtormy weather, and indeed produced a TEMPEST of the firſt magnitude, the rage of which was ſo great, that one of thoſe who had been uſed to predict its downfal, was heard to ſay; *if the Edyſtone Lighthouſe is now ſtanding, it will ſtand till the* DAY OF JUDGMENT: and in reality, from this time, its exiſtence has been ſo entirely laid out of men's minds; that, whatever ſtorms have happened ſince, no enquiry has ever been made concerning it*.

Mr. RICHARDSON, though a very ſound hardy maſon, was not a man converſant in literary deſcriptions. The pen was therefore, on this occaſion, taken up by my very valuable and ingenious friend Dr. JOHN MUDGE; who gave me two letters upon the ſubject of this ſtorm; and which, coming warm from the heart, ſo much exceed any thing I can compoſe, that I cannot do ſo well as to inſert them.

" DEAR SIR, *Plymouth*, Friday 15th January, 1762.

" Accept my moſt ſincere congratulations on the ſafety of the *Edyſtone*; as well from the danger that has threatened it, as that I think the dreadful ſtorm it has withſtood, will for ever remove any anxiety about its being injured in future, by the united force of the wind and ſea.——It blew very hard the beginning of laſt Monday night, but increaſed with incredible fury towards Tueſday morning; when about ſix, partly from the long ſoutherly winds, but principally by its concurring with the ſpring-tides, it afforded the moſt horrible ſcene of devaſtation. This tide roſe full two feet higher, than when the *Victory* was loſt, and when the *Fiſh-houſe*† was carried away; or than was ever known in the memory of the oldeſt man living. The ſeas came in bodily over the *Barbican* wall, but one wave with ſuch irreſiſtible violence, that it ſwept away the parapet, below its foundation; and in its return carried off five people then upon it, all of whom

* Witneſs the ſtorm in which the *Haſewell Indiaman* was loſt!——And though the public papers were full of the immenſe damages done by it at *Plymouth*, and in the *Sound*; (in particular a ſhip in the harbour that broke looſe, and beat down *a houſe*, will be very well remembered) yet not a ſingle word was ſaid about the *Edyſtone Lighthouſe*.

† The *fiſh-houſe* was a building ranging acroſs the mouth of *Sutton Pool*, which may be called the *interior harbour* of Plymouth. Betwixt the weſt end of the *fiſh-houſe*, and the moſt projecting eaſtern end of the Jetty, or ſhort pier, called the *Barbican*, an opening was left of about 65 feet wide; by which the ſhips entered.

were drowned. The new *Lammy Pier* was ſwept clean away*. Prodigious loſſes have been ſuſtained by the ſhopkeepers on the quays; as in ſome of their ſhops near the *Barbican*, the water was as high as their *counters*; and the quays themſelves are in ſo ruinous a condition, and ſo much of them carried away, that had the gale continued till the next tide, it is highly probable ſome of them would have been wholly ſwept away, and the houſes with them.

"In the midſt of this confuſion there was no leſs than ſix large merchant ſhips wrecked in the very harbour, ſome of which were beat to pieces, but all loſt; and this in the ſhort ſpace of 300 yards, betwixt *Teatſhill* and *Bearhead*.——There were nine men of war in the Sound; ſeveral of which were conſtantly firing ſignals of diſtreſs. Some cut away one, others two, another three; and one loſt all her maſts and her bowſprit. Three of them only eſcaped with all their maſts ſtanding; one of which, to avoid immediate deſtruction on the ſouth ſide of *Mount Batton*, was by the great dexterity of the pilot brought in within the *Fiſher's Noſe*, and run aſhore under the *Lammy*: but this was when the ebb had made conſiderably; ſo that ſhe was ſafely got off the next tide. But it exhibited a very uncommon appearance; as I believe it was the firſt time that ever a man of war was ſeen in that place.——In the *Hamoaze* the men of war were all this while firing ſignals of diſtreſs; and ſome of them ran foul of each other. The ſea came over the dock gates, into the dock where the *Magnanime* was; but as there did not come in enough to float her, it did no conſiderable damage. The new dock was likewiſe filled.——I will only mention one circumſtance more, to give you ſome idea of the extreme agitation of the ſea: the *Froth* of it flew clean over the walls of the *Garriſon*; and in ſuch quantities, that in one ſituation a centinel was obliged to quit his poſt.

"In the midſt of all this horror and confuſion, my friend may be aſſured, that I was not inſenſible to his honour and credit; yet, in ſpite of the high opinion and confidence I had of his judgment and abilities, I could not but feel the utmoſt anxiety for the *fate* of the Edyſtone: and I believe poor RICHARDSON was not a little uneaſy.——Several times in the day, I *ſwept* with my teleſcope from the Garriſon, as near as I could imagine the line of the horizon; but it was ſo extremely black, fretful, and hazy, that nothing could be ſeen; and I was obliged to go to bed that night, with a mortifying uncertainty. But the next morning early I had great joy to ſee, that the *Gilded Ball* had triumphed over the fury of the ſtorm; and ſuch a one as before I had not a conception of.——I ſaw the whole ſo diſtinctly from the bottom to the top, that I could be very ſure the lantern has ſuffered nothing.——It is now my moſt ſteady belief, as well as every body's here, that its inhabitants are rather more ſecure in a ſtorm, under the united force of wind and water, than we are in our houſes from the former only."

307. I RECEIVED the above letter in *Yorkſhire*, where we had had very ſtormy weather; the account of my friend was therefore equally agreeable and aſtoniſhing: yet, notwithſtanding his letter announced the general ſafety of the building; and that nothing very bad could have happened, even to the lantern, I could not conceive, that his expreſſion *the lantern had ſuffered nothing*, could be ſtrictly and literally true; I therefore wrote in return, deſiring he would ſend me a circumſtantial account of the damages, after the houſe had been *viſited*. The following is an extract of his ſecond letter, dated *Plymouth* the 24th January, 1762.

"The boat went off, with an intention to land, on Friday ſennight; but there was ſo great a ſea, and the wind being too much to the ſouth, they deſiſted till the next day; when the wind being a point to north of the weſt, and better weather, they got near the houſe, landed their things, and had a long converſation with the people.

"SMART tells me, that the ladder was carried away†; and ſome ſmall matter of putty, which was cracked by the laſt ſummer's heat, was waſhed off from the lantern. This was all that the violence of the

* An addition by Government for the protection of ſmall veſſels laying againſt the *Victualling Office*, which is built upon the ground called the *Lammy*, extending from the Barbican ſouthwards to *Fiſher's Noſe*; a prominent point of rock ſo named.

† This ladder, by which the houſe is aſcended, from the top of the rock to the entry-door, was at firſt a common ladder, like that of a *Light-houſe*. It was ſo made that the ſea might not have much hold of it; at the ſame time it was firmly laſhed to Iron *Eye-bolts*, drove into the ſolid courſe.; yet this, by the before-mentioned inſtances, appearing not ſufficient to reſiſt the ſtorms; I have ſince ordered it to be made, with a joint in the middle; ſo that when it is not in uſe, it may be drawn into the entry, and laid in the paſſage.

ſea

ſea had effected; that there was not ſo much as a ſingle pane of glaſs broke. That the lantern was ſecured by (that perfection of ornament) the *Cornice*; which, when the ſea roſe to the top of the houſe, blanched it off like a *ſheet*. They inſiſted on it, that the ſea went *bodily* over the top, for, that it came in through the vents of the ball, and filled the ſockets of the candleſticks*. They were aſked whether they had been under any uneaſineſs; they ſaid, not in the leaſt, as the houſe had not been affected by it in any other way than they had before experienced.——The ſtorm in the evening of Monday begun at the ſouth-eaſt, and then they felt very ſenſibly a tremor from every ſtroke of the ſea; ſo that while it continued there to act upon the natural cavern in the rock†, it gave them ſome uneaſineſs; which though they now believed unneceſſary, yet they could not help wiſhing it was filled up.——Now, though I look upon this as a proof, that no ſtorm will ever affect the houſe, as it is a plain ſmooth ſurface; and though a leſs ſea has a greater influence on the rock at low water, than a mighty one has upon the houſe itſelf; yet I muſt ſay, that I concur with them in wiſhing it was done; and that for two reaſons: One is, I ſhould be glad to ſee every, the leaſt appearance, of defect, removed; and the other, that I ſhould hope it would give me a chance of ſeeing my dear friend once more, here. In earneſt, I wiſh you'd complete the rock too, as well as the houſe; for ſo many vibratory ſtrokes, can do it no ſervice.

" You ſeem to have been greatly affected by the little I have ſaid of the horror of this Storm; but believe me, it cannot give you even a tolerable idea of it. It has, upon a moderate computation, done above £. 80,000 worth of damage in the Harbour and Sound: and I cannot help repeating again, that I am very ſure you may for ever rid yourſelf of an uneaſy thought of the houſe, as to its danger from *wind* and ſea."

" P. S. I broke open this letter to mention a whimſical circumſtance, that comes in my head: One of the articles (beſides ſugar, ſome flour, &c. which they landed at the houſe) was a *Callipot of putty*, to repair, as I ſaid, the *only derangement* the houſe had ſuffered."

308. IN the year 1766, having a call to *St. Ives* in *Cornwall*, I gladly ſeized the opportunity of viſiting my friends at Plymouth, and the Lighthouſe: on this occaſion, I was commiſſioned by the *Gentlemen Proprietors* of the *Edyſtone*, to inſpect that building, and report my obſervations; which were as follows.

Extract of the REPORT *of* JOHN SMEATON, Engineer; *concerning the State and Condition of the* Edyſtone Lighthouſe, *from a View thereof, taken the* 10*th Auguſt*, 1766.

HAVING carefully inſpected this Edifice, I had the ſatisfaction to find, that no one part had in the leaſt degree given way to the rage and violence of the ſea; but that the maſs of building was found and firm as at firſt: nevertheleſs there appeared ſome matters, that I thought worthy of regard: which are in order as follows.

The cement every where below high-water mark; and from three to ſix feet above it, was perfectly entire, as left by the *Trowel*, and ſeems changed to the colour and conſiſtence of *Iron-Stone*.——From thence to ten or twelve feet above high-water mark, the cement appears here and there to be ſomewhat impoveriſhed in the joints, or fretted; and I obſerved that this was more ſo on the *Eaſt* ſide than on the *Weſt*: above the parts laſt deſcribed, the cement appears perfectly fluſh in the joints, quite to the top, as left by the trowel, being no ways altered in colour or conſiſtence.

From the above appearances it ſeems to me, that thoſe parts of the building that are generally wetted every tide, are in the higheſt degree of preſervation; thoſe that are wetted ſeldom, are nearly the ſame; but thoſe that are frequently wetted, but not always, have ſuffered moſt by the alternate action of the ſun, wind, and of the ſea ſalts: was this to go on ſeveral years longer, nothing is likely to happen that would materially affect the ſtrength of the building; yet in a ſtructure of ſo much conſequence, and which can ſo eaſily be reſtored to its primitive ſtate, it would ſeem negligence to let it remain unrepaired.

The *electrical* conductor is compleat down to the rock, as to uſe; but of the chain that hangs from the top of the rock into the water, about half of the lower part is gone; by its wearing away with ruſt, and

* This might poſſibly happen by the falling of a detached maſs of water into the *Vents* made for the clearance of the ſmoke.

† See Plates N° 6, 8, and 14.

beating

beating againſt the rocks. I have ordered a new one to be made of ſtronger iron. From the rock, for about twelve or fourteen feet upwards, the communication is by *Braſs* bars let into the houſe ſide, in a little groove or gutter, in which they lie buried in putty*; and which ſeem to ſtand very well; the reſt of the outſide communication is by the original ſtrap of lead, that I fixed there†; but as about half a yard of the lower part of the lead is getting looſe, I ordered Mr. RICHARDSON to let in another length of braſs bar, like the former; and ſo on, as the lead fails.

The balcony rails have as yet ſuffered very little, conſidering their expoſure: but as flakes of ruſt ſeem gathering under the paint, I ordered it to be knocked off with proper tools before a freſh coat of paint is laid on.

The whole of the lantern is in remarkable preſervation, ſcarcely a ſpeck of ruſt appearing on the outſide, and only a few ſpecks within; which are chiefly upon the ribs, and knee pieces under the cupola; thoſe ſpecks I ordered to be firſt ſcraped off, and then freſh paint laid on.

I was much ſurprized to ſee the gilding of the ball, which, notwithſtanding its expoſure, and the ſmoke of the whole houſe going through it, appears as bright as it did the firſt day it was ſcrewed on. The lantern has always continued remarkably water-tight, not the leaſt wet ever beating through any part of it; except in high ſtorms; and what gets in between the glaſs and the copper frames, by the drying and cracking of the putty; but this ſo ſeldom and ſo little, as ſeems not worth regard.

The loops and crooks of the doors and window ports have ſuffered moſt of all by the ruſt; and particularly thoſe parts of the iron that are on the *inſide*; but as all *theſe* things are renewable at pleaſure, they are not to be eſteemed of any conſequence; eſpecially as they ſeem likely to laſt many years.

The *Cavern* in the rock on the eaſt ſide, ſeems exactly in the ſame ſtate I left it. In hard gales of wind at eaſt, it is ſaid to cauſe a wonderful noiſe; and a ſenſible tremor in the building: but though it makes more noiſe, the light-keepers ſay it does not affect the building, with ſo ſenſible a *vibration*, as the heavy ſeas from the S. W.; and yet even thoſe are not much more than to be readily perceivable in the greateſt ſtorms ‡. Whether this cavity in the rock may ever prove of any detriment to the building is not to be determined with certainty: all that can be ſaid, is, that hitherto it does not ſeem to have been of any hurt thereto. I could undertake to fill it up and make it ſolid, at the expence of about £. 250, beſides my own attendance, if it was thought worth the charge.

Beſides the pleaſure of finding all the main *Stamina* perfectly ſound and firm, and every thing elſe likely to endure for many years to come; I had the ſatisfaction of finding every thing in the inſide ſo perfectly neat and clean, that it ſeemed as if it had not been a twelvemonth in uſe.

Aylloſe, 30th Auguſt, 1766. J. SMEATON.

308. FROM this time nothing further occurred till the year 1777, when having a ſecond call into *Cornwall*, I again took the opportunity of viſiting *Plymouth*: and though I had no commiſſion to inſpect, &c. yet my own curioſity prompted me to viſit the Lighthouſe: and I had the great ſatisfaction to find that Mr. RICHARDSON had ſo well attended to my laſt inſtructions; and its condition was ſo nearly the ſame as in the year 1766, that very nearly the ſame report would have ſerved; every thing was neat and clean, and in good condition; no other change or repair having happened, except that of repeated paintings of the metalline parts, which appeared ſtill in high preſervation. This viſit to the Lighthouſe was in the month of September.

* See § 292.

† From the report of SMART and BOWDEN I concluded the *whole* of this ſtrap was waſhed away, (ſee § 304): hence we may ſee how very liable men are to be miſtaken in matters to which they are not perfectly competent; even where they have no intereſt in deceiving or being deceived.

‡ Hence we may ſee demonſtrably, how much the ſame things are liable to be magnified, when people are under fears and apprehenſions; and perhaps at the ſame time inclined to magnify; HENRY EDWARDS ſays in his letter, § 302. "*the houſe did ſhake as if a man had ſtruck againſt it.*" HENRY EDWARDS had at this time quitted the ſervice; but the effects of the ſea upon the houſe muſt be preſumed the ſame.

310. IN

310. IN the year 1787, having a call to *Plymouth Dock*, I again took this opportunity of gratifying my curioſity by inſpecting the Lighthouſe; and alſo ſpent ſome days in getting the neceſſary *Trigonometrical* operations for determining the real diſtance of the *Eddyſtone* from the *Ramhead*, from *Plymouth Sound*, and from *Plymouth Harbour:* and though I did not find them materially different from what I had put them down in the former part of this work, § 4. (which was then printed) as deduced from bearings, compared with the maps of the adjacent coaſts, from whence Plate N° 2 was compiled: yet, obſerving ſome contrariety in the reſults, I was deſirous of ſettling this matter from more authentic materials, than my opportunities would give me leave to collect while the Lighthouſe was building and finiſhing. The particular reſult of theſe operations I ſhall give with the *technical* deſcription of Plate N° 18.

311. MY viſit to the houſe was the 3d Auguſt, 1787; and I then had the ſatisfaction to find both ſtone and iron ſo very nearly in the ſame ſtate, as I had found and reported it twenty-one years ago, in the year 1766, that I was agreeably ſurprized: the only thing in which I could perceive a change, was, that the cement in the upper works was in moſt places ſenſibly corroded. I could not, however, eſtimate the quantity in general, at more than one ſixth of an inch, that the preſent mortar ſurface wanted of *fluſh* with the face of the *Granite*. Had the whole building been of *Portland* ſtone, and ſuppoſed, in ſuch a ſituation, to have loſt of its *whole ſubſtance* an equal quantity: had the mortar waſted equally, the whole would have been a fair ſurface.——Of all the lower parts, including the whole work of the year 1757, being the firſt year's building, and which is generally wet every tide, there did not appear on this laſt viſit to be the diminution of a grain of ſand, but they appeared exactly as the ſame parts are reported to be in 1766: that is, the mortar having the appearance of *Iron Stone*; the *Limpet* ſhells, and ſea weeds, fixing indiſcriminately upon the mortar and the ſtone. But above that, as the eaſtward joints are more ſenſibly affected, and ſomewhat irregularly; to about the height of the entry-door, and after that are pretty uniformly in the degree I have already related; I am much inclined to ſuppoſe, that in raging ſtorms the ſand is raiſed from the bottom, and mixed with the water, and being driven violently againſt the building, may be capable of grinding, and making an impreſſion upon what is compounded with calcareous matter, (however hard it may be, and in reality is) that it cannot make upon the *Moorſtone:* which nothing ſeems to affect but a conſiderable degree of fire.——This is, however, not the caſe on the S. W. ſide; though that ſuſtains the firſt ſtroke of the ſea: for the *ſea-weed* fixing itſelf the higheſt on that ſide, becomes a defence to the joints in this part.

Since my viſit in 1777, the very *careful* and *diligent* Mr. RICHARDSON departed this life.——Mr. RICHARDSON, during life, remained ſenſible what patience and aſſiduity were neceſſary, during the courſe of the work of the firſt and ſecond year, not only to repair the *pointing* when injured by a rough tide; but to *look to it* again and again till it had *ſtood* a *rough* tide: On the preſent viſit I was diſguſted with ſeeing the joints, in ſeveral places of the ſecond year's work, made up with glazier's putty, which was an expedient of the light-keepers, when the maſons mortar did not happen to ſtay on, after their departure. This, though it would often ſtay in the joint when the mortar would not; yet, being of *unctuous* matter, it hinders the union of the proper *cement* with the ſtone, and becomes a means of preventing thoſe joints from being made compleat and fluſh in the way they were at firſt. It alſo diſgraces the work with party-coloured mortar.

312. AS the *Iron Work* ſtill endures with very little apparent injury, having had a coat of paint every two years; and this ſtanding remarkably well, in ſpite of its expoſure to the ſea-ſalts, many perſons have been curious to know the manner in which this part of the work was originally performed.——I then conceived the expoſure of the *rails* in particular to be ſuch, as to require every advantage that could be put in practice: and after conſidering the matter, I determined upon the following method; which, as it appears to have ſucceeded, I dare ſay my reader will like to know.——I had obſerved, that when iron once gets ruſt, ſo far as to form a *Scale*, whatever coat of paint or varniſh is put over this, the ruſt will go on progreſſively under the paint, unleſs it is eradicated by being knocked off, and ſcraped.——The moſt effectual way therefore ſeemed, to endeavour to apply the *protective* coat, before any ruſt could be formed.

After the rails were made in eight compartments, and ſcrewed together, I ordered that they ſhould not come out of the ſmith's ſhop, till they were to undergo the following operation.——A fire was

made, though not very ſtrong, yet extenſive enough to heat the whole of a compartment together, tolerably equal, till the iron came to about, or rather above, a *blue* heat; this part was then removed and another applied; and while it was heating, a couple of men with bruſhes, *ſtruck* over the ſurface of the former with raw *Linſeed* oil. This at firſt would ſmoke, and nimbly run into every joint, crevice, and flaw in the iron; and the operation was continued, till every part had at leaſt been gone twice over; and the oil would begin to lie fluid on its ſurface. It was then ſet by to dry; and the reſt followed in the ſame manner. The next day, if properly done, the ſurface of the whole would appear to be covered with a thin coat of varniſh. The doing this to *purpoſe* is what the main matter conſiſts in*. As ſoon as it was well dried a couple of coats of common white lead and oil paint were given: after theſe were dry, the Rails came down by ſea to Plymouth, and from thence were carried out, and ſet up upon the Lighthouſe; and there, as I have related, they were finiſhed with a *couple* of coats more, in place.——Doubtleſs by theſe carriages, the coats laid on at *London*, were a good deal ſcratched, and in point of *appearance* ſpoilt, but in point of utility were little the worſe: becauſe, it was only the *prominent* parts that could be ſcratched and rubbed; and therefore the bruſh could not fail to make theſe good, in *preference*; and, as they would get two coats in *place*, they muſt be conſidered as ſufficiently covered; whereas, all the intricate, retreating parts, would have the whole *five* coats remaining entire upon them.

313. ON this viſit I found the luſtre of the ball was conſiderably diminiſhed. But as the *Gilding* was perhaps the only part of the whole work that was *merely Ornamental*; and as much coſt did not attend it, in its firſt application; as it has laſted thirty years in good ſplendor, and is not yet wholly effaced; it may be alledged, that it has ſufficiently anſwered every purpoſe there was in view at the time: and whenever it ſhall appear to be *neceſſary* to renew it, I doubt not but *ways* and *means* will be found.

In examining the ſkirt of the leaden cap, turned under the *drip* of the *Corona*, that I had carefully batted to the ſtone (ſee § 286): on the ſouth-weſt ſide I found it to hang down more than an inch. On enquiring whether the great ſtorms had any ſenſible effect upon it, I was told by the light-keepers, that in the ſtorm of January 1786, (remarkable for the loſs of the *Halſewell Indiaman*) the lead was conſiderably raiſed up, by the action of the ſea, on the ſouth and S. W. ſides; but that they had beat it down again, as well as they could. ——Of this I apprized my reſpected friend HENRY TOLCHER, Eſq. the *Agent*; and that it would be neceſſary to ſend off an intelligent workman, to *bat* the lead carefully to the ſtone under the drip, as at firſt; and that where it was become too broad, it might be cut narrower.——I conceived that the feet, and other bodies that are continually making impreſſions, and ſtriking ſmall blows upon the balcony floor, had in time ſtretched out the lead: and its own weight would alſo contribute to encreaſe the effect.

314. BEFORE I conclude this narrative I wiſh to meet an enquiry, that has very often been made with a degree of ſurprize: How is it poſſible to find men that will ſeclude themſelves from the *world*, and the *comforts* of life, for ſo ſmall a conſideration, as a ſalary of £. 25 a year; when I found myſelf under the neceſſity of giving ſuch high wages to the *workmen* employed in erecting it? intimating, that it might rather be conſidered as the *alternative* for condemned *Felons*, than an appointment for which people would make *intereſt*.——The caſe is, the Lighthouſe is ſupplied with light-keepers from a different ſort of men to thoſe, the queſtion ſuppoſes †. A man while he is in his youth and ſtrength generally enters into the engagements of a family, and an induſtrious man ſo ſituated, no conſideration would hire to part with his *liberty*. But when he comes to be above the age of *Sixty*, and has ſtill his bread to earn by his own labour; an *eaſy birth*, in which he can get as much as he could do formerly, becomes a very eligible thing; eſpecially to thoſe who are not otherwiſe encumbered. To elderly *Seamen*, it may be conſidered as an *Aſylum* ſomething like equivalent to *Greenwich Hoſpital*.——Formerly there were ſeldom leſs than half a dozen appli-

* A perſon repeating this proceſs, if he finds the oil not to be dry like varniſh the next day, may conclude; either, that he has continued the *ſtriking* with oil too long, till the iron was too cold; or, that he had not heated it ſufficiently.

† I was applied to in the courſe of the *laſt* ſeaſon, by a *philoſopher* kind of man, to be one of the *light-keepers*; obſerving, that being a man of ſtudy and retirement he could very well bear the confinement, that muſt attend it: I aſked him if he knew the ſalary: he replied, not; but doubted not it muſt be ſomething very handſome. When I told him it was £. 25 a year, he replied, he had quite miſtaken the buſineſs; he did not mean to ſell his *liberty* for ſo low a price; he could not have ſuppoſed it leſs than three times as much.

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cants upon the agent's liſt, ready to ſupply a vacancy; and as no one was under a neceſſity of ſtaying longer, than till, after giving notice of his intention to quit the ſervice, a freſh man was ſent out to fill his place, thoſe vacancies happened frequently. At preſent they happen ſo rarely, that very few think it worth while to apply. JOHN IRELAND, who is the *ſenior* of the preſent ſet, entered with me in the year 1756 as a *ſeaman*. When the building was finiſhed, JOHN, being ſtout, hearty, and *willing to work*, ſhipped himſelf on board a trading veſſel, and continued for ſome time to uſe the ſea. However, a few years more of hardſhip, and *advance* in life, occaſioned him to change his mind; and, I believe, on EDWARDS quitting, he entered. I found him there in the year 1766; in the year 1777; and on my laſt viſit in 1787.—— The *ſecond* man I alſo found there in my viſit of 1777; and the preſent *third* man, who was at this time taking his *month* on ſhore, (ſee § 57) I was told had been a light-keeper *four* years; and had ſucceeded one who had been there *fourteen* years; and who neither being very old nor very infirm, probably would have been in the Lighthouſe at this time, had his death not been *premature*, which occaſioned the vacancy*. ——Theſe facts, more ſtrongly than any arguments, prove that this Lighthouſe as an *Habitation* (ſingularly ſituated, expoſed, and circumſtanced as it is; and where water was never known to freeze) is not only remarkably *healthy*; but really *comfortable* to a degree, that renders it *eligible* to a certain claſs of men; who do not conſider their abode there as any infringement upon their *liberty*, becauſe they well know it is in their own power to put a period to it, whenever they chuſe.

* As the death of this man exhibits a remarkable *trait* of *human nature*, on this account I inſert it. In the fourteen years that he had been here, he was grown ſo attached to the place, that for the two ſummers preceding he had given up his *turn* on ſhore to his companions, and declared his intentions of doing the ſame the third; but was *over perſuaded* to go on ſhore, and take his *month's turn*. He had always in this ſervice proved himſelf a decent, *ſober*, well-behaved man: but he had no ſooner got on ſhore, than he went to an *Alehouſe*, and got intoxicated. This he continued the whole of his ſtay; which being noticed, he was carried in this intoxicated ſtate, on board the Edyſtone boat, and delivered in the Lighthouſe, where he was expected to grow ſober; but after lingering two or three days, he could by no means be recovered. The reflections ariſing, I leave to my reader.

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315. THE following words, letters, and figures, were ſunk into the Moorſtone with the point of a pick.

Upon the firſt ſtone of the foundation - - - - 1757.

Over the Entry-door - - - - - 1758.

Round the upper Store-room, upon the courſe under the ceiling,

EXCEPT THE LORD BUILD THE HOUSE
THEY LABOUR IN VAIN THAT BUILD IT.
PSALM CXXVII.

Over the ſouth window, on the outſide of the dwelling room, or kitchen - 1759.

Upon the outward faces of the octagon baſement of the lantern,

✠ • NE • *door* • SE • S • SW • W • NW.

Upon the laſt ſtone ſet, being that over the door of the lantern on the eaſt ſide,

24TH AUGT 1759.
LAUS DEO.

GENERAL ABSTRACT *of the Progress of the Work of the* EDYSTONE LIGHTHOUSE.

DATE.		Time upon the Rock. Hours.	Time upon the Rock. Days and Hours.	Number of Pieces of Stone.
1756. Auguſt 5.	Began to cut the Rock for receiving the foundation.			
November 22.	The principal parts thereof being completed; the *Neptune Buſs* quitted the *moorings*; after which ſhe was driven out to ſea by a ſtorm, to the weſtward of the *Land's End*. Returned to *Plymouth* the 26th.			
	In this year the time out upon the work was 110 days = 15 weeks 5 days: and upon the Rock — — — — —	348¾	14 12¾	
1757. June 12.	Landed the firſt ſtone.			
Auguſt 11.	Completed the firſt ſix foundation courſes. — — —	342½	14 6½	123
October 1.	Finiſhed three courſes of the ſolid ſhaft, conſiſting of 53 principal pieces each; and one ſtone let into the Rock, to make good a *chaſm* therein over the *Cavern*. — — — — —	288½	12 —½	160
	In this year the time out upon the work was 113 days = 16 weeks 1 day: and upon the Rock — — — —	631	26 6½	283
1758. July 2.	Landed the firſt principal piece of courſe X. being the firſt ſtone this ſeaſon.			
Auguſt 8.	Completed the *Entire Solid* up to the Entry-door, incluſive of courſe XIV.	237	9 21	265
September 24.	Finiſhed the ſolid to the Store Room floor, incluſive of courſe XXIV. —	416½	17 8¼	383
October 7.	The laſt ſtone of this year's work was fixed; having completed the walls of the *Store Room*, conſiſting of 78 principal pieces; and ſet 14 pieces of the firſt *vaulted Floor*. — — — —	127½	5 7½	92
	After which, on the 8th, the *Neptune Buſs* parted her cable in a ſtorm, and was driven into *Torbay*; from whence ſhe got into *Dartmouth Harbour*: and afterwards returned to *Plymouth*.			
	In this year the time out upon the work was 99 days = 14 weeks 1 day: and upon the Rock — — — —	781	32 13	740
1759. July 5.	Landed and began the work of this ſeaſon.			
Auguſt 16.	Completed the *Balcony Floor*, and therewith the *Main Column* — —	502	20 22	398
—— 26.	The *Baſement* of the Lantern, the ſtone Stairs in the *Well-hole*, and all the ſtone work completed. — — — —	119¼	4 23½	72
October 9.	The *Lantern*, and the *whole* of the *Building*, with its equipments, completed: the workmen left the houſe, with three light-keepers and proper ſtores therein; with orders to light the houſe upon the 16th. Unmoored the *Neptune Buſs*, and carried her into *Plymouth Harbour*. — —	292	12 4	
16.	This evening, according to the appointment of the *Corporation* of TRINITY HOUSE, the light upon the Edyſtone was *rekindled*.			
	In this year the time out upon the work was 99 days = 14 weeks 1 day: and upon the Rock — — — —	913¼	38 1¼	470
	Totals of the four years; out upon the work 421 days = 60 weeks 1 day: upon the Rock — — — —	2,674	111 10	1,493

Beſides the larger Pieces of ſtone above ſpecified, the *maſs* of *Maſonry* incloſed the following ſmaller parts; which the *regularity* of the conſtruction enables to particularize.

75 Large cubic *Joggles* and *center-plug* ſtones.
162 Cubic *Joggles* of 6 inches, uſed in the *Well-hole* courſes.
399 Flat *Joggles* in the courſes of the rooms and lantern.
399 Joint ſtones in D° ——————————.
1,800 Oaken *Trenails* of 1 ¼ inch diameter uſed in the ſolid.
4,570 *Pairs* of oak wedges for ſteadying the ſtones of the ſolid.
8 Large circular chains, two uſed at each vaulted floor.
221 Strong iron cramps, uſed in the walls of the rooms and lantern.
5 D° — — in the foundation, in conſequence of accidents.

N.B. The whole time intercepted betwixt the *firſt ſtroke* upon the Rock, and leaving the Lighthouſe compleat, was 3 years, 9 weeks, 3 days.

And the whole time from the Fire taking place, in December 1755, to the rekindling of the light, October 1759, was 3 years, 10 months, 16 days.

The whole time of working upon the Rock (being 111 days, 10 hours) amounts ſcarcely to SIXTEEN WEEKS.

APPENDIX.

Containing an Account of the Eſtabliſhment of the preſent Lights *upon the* SPURN POINT, *by Direction of the Honourable Corporation of* TRINITY HOUSE, *Deptford Strond*, LONDON.

316. IN the year 1676 a patent was granted by *King* CHARLES II. to JUSTINIAN ANGELL, of *London*, *Merchant*, enabling him to *continue*, *renew*, and *maintain* certain lights that he had erected upon the *Spurn Point*. Which lights were erected at the requeſt of the maſters of ſhips uſing the *northern Trade*; who, in their petition to his *Majeſty*, repreſented that a very *broad long Sand*, about ſix or ſeven months before, had been diſcovered to have been thrown up near the mouth of the river *Humber*, upon which they had had great loſſes; and by means whereof they ſailed in great danger in the night; and that having conſidered, that lights erected upon the *Spurn Point* would in future prevent ſuch danger, this had induced them to apply to Mr. ANGELL, as being the proprietor of the *only* piece of ground, that was adapted to the purpoſe; and who, at their requeſt, had erected two lights thereon; which the petitioners found to be not only of great benefit, but an *abſolute ſafety* to all navigators on that coaſt.

In proceſs of time, the *Broad Long Sand*, complained of in the petition, became itſelf a dry land at high water; and which continued to increaſe conſiderably: for, antecedent to the year 1766, the lights thus eſtabliſhed by Mr. ANGELL were, by the gradual extenſion of the real point of the *Spurn*, become *now* at ſo very great a diſtance therefrom, that the maſters of ſhips loudly complained, that the ſaid lights were ſo far from being of that benefit they originally had been, that they were become detrimental to them; by inducing them to ſuppoſe themſelves more near to the *point* than they in reality were. In fact, that they were *deceived* thereby, and in conſequence many very great loſſes had lately happened *.——Wherefore an application was made to parliament in the year 1766, promoted by the *Corporations* of the TRINITY HOUSES at *Deptford Strond*, and *Hull*, for removing the ſaid lights; and an act paſſed in conſequence, *Anno ſexto* GEORGII III. *Regis*, *Cap.* 31. "*An act for taking down and removing certain Lighthouſes now ſtanding near the* Spurn Point, *at the mouth of the* Humber, *and for erecting other fit and convenient Lighthouſes inſtead thereof*;" whoſe preamble ſets forth, that JOHN ANGELL, of *Stockwell*, in the county of *Surry*, Eſq. was owner of three fourth parts of the ſaid Lighthouſes, duties, and profits; and that LEONARD THOMPSON, of *Sheriff Hutton* in the County of *York*, Eſq. was proprietor of the other fourth ſhare thereof. That Mr. ANGELL having been applied to by the ſaid *Corporations*, and alſo by the ſaid Mr.

* The ſpot of ground called the *Spurn Point*, ſeems to have undergone great changes; for in CAMDEN's time, about a century before the petition for erection of lights, there ſeems to have been no more than a pretty ſharp *Head* of *land*, that did not extend far from *Kil ſey*, and was then called *Spurn* HEAD. His words are "*Inde in ipſâ promontorii Linguld quà maximè in Conum contrahitur &* SPURN HEAD *dicitur* "KELLNSEY *viſtur viculus.*" CAMDEN's *Britan.* 8vo. Edit. 1590, p. 580. It ſeems therefore gradually to have been drawn out to a greater length, and to a ſharper point of land: taking the name of *Spurn* POINT, upon which the *Lighthouſe* was erected, and to which the *broad long ſand* afterwards attached itſelf, and became dry land in the ſhape of a *Spoon*, which form it ſtill retains.——There is alſo an obſcure tradition current, that upon a flat of ground juſt within the *Point* that now but juſt *dries* at low ſpring-tides, there ſtood a conſiderable town called RAVENSPURN: and ſome pretend they have ſeen traces of its foundations.

THOMPSON, to change the ſituation of the ſaid Lighthouſes, ſo as to anſwer the ends and purpoſes for which they were originally deſigned; and this application having been ineffectual, it is thereby enacted; That the ſaid LEONARD THOMPSON ſhould be intitled, as ſoon after the firſt day of June 1766 as conveniently could be, to erect two new and ſufficient Lighthouſes, with ſuitable offices and conveniences, at or near the ſaid *Spurn Point*; according to ſuch plan and eſtimate, as the *Maſter*, *Wardens*, and *Aſſiſtants* of the ſaid *Corporation* of TRINITY HOUSE, *Deptford Strond*, ſhould by writing under their common ſeal ſpecify, appoint, and approve of: and in the mean time, and until the ſaid new Lighthouſes ſhould be completed, to erect two *Temporary Lights*, as near as may be to the reſpective places where the new Lighthouſes ſhall be appointed to be built: and, as occaſion might require, to enlarge, contract, alter, or remove the ſame, with the conſent, and by the direction, of the ſaid Corporation ſo ſignified. The ſaid Lighthouſes to be ſubject to the viſitation of the *Trinity Houſes* of *Deptford Strond* and of *Hull*.

317. MATTERS being in this ſtate, the *Corporation* of TRINITY HOUSE, *Deptford Strond*, did me the honour to requeſt my attendance to meet a Committee of their body, appointed to proceed to the *Spurn Point* to take a ſurvey, and give directions in reſpect to the ſituation and erection of two new Lighthouſes; and of temporary lights, purſuant to the act of parliament lately paſſed for that purpoſe. Accordingly I met JOHN BARKER, Eſq. and THOMAS BENNET, Eſq. the Committee appointed, at *Hull*, the 22d June 1766; and the next day attended them, and a deputation of the *Trinity Houſe* of *Hull*, to the Spurn Point by water: when the gentlemen of the ſaid Committee, after examining the ground, and hearing every matter of information that was offered to them, fixed the places for the two *Lighthouſes*; and alſo for the temporary lights, as near the extremity of the point of the Spurn, as they could with the appearance of ſafety be built; and which ſituation was at the diſtance of more than a mile from the old Lighthouſe: all which they propoſed to lay before their Board for their concurrence.

They particularly enquired from me, conſidering the ground where the propoſed Lighthouſes were to ſtand, being a ſand thrown up by the ſea, in the courſe of leſs than a century, whether I could undertake to erect Lighthouſes *of Brick* thereupon: and particularly, if one of them was to be ordered of 90 feet high to the center of the light?——To this I anſwered; That though the ground whereon they propoſed to erect the lights was *new Ground*, in compariſon of that whereon the preſent Lighthouſe ſtood; yet, as it appeared to be of the ſame quality, whereon that had already ſtood 90 years, without apparent crack or ſettlement; I did not doubt of making a foundation, at leaſt as much more firm than that of the old one, as the new building ſhould be more lofty; and that it would ſtand, as long as the ground remained, that it ſtood upon: and in regard to *this*, it was the unanimous opinion of the whole company, that as the *Spurn Point* was a piece of ground that was *rapidly increaſing*, there would be no danger of the ground being waſhed away. Therefore the judgment would be, to place the new lights as *near* the preſent point as poſſible, that there might be the greater courſe of years before the land, that doubtleſs *would be added*, ſhould cauſe the neceſſity of a *ſecond removal*.

In reſpect to the temporary lights; having then examined the *low light* machine, called a *Swape* *: though that was ſcarcely capable of hoiſting the light above 25 feet above ordinary high water, yet, I doubted not but to produce a machine upon the ſame principle, ſo much more complete, that it ſhould hoiſt the light 50 or even 60 feet high if required: and which I recommended to their conſideration.

* The lights then ſubſiſting though in the original *patents* and the preſent act they are called *Lighthouſes*, yet it does not appear that the low light was ever exhibited otherwiſe than upon a *Swape* (a north country term for a *Lever*, when fixed upon a centre, and acted upon by the hand) and which works in a way, very ſimilar to that by which water is drawn by a bucket out of ſuch wells as are not deep, in the garden grounds about London, and many other places: and which machine, as the coaſt wore away, being moveable, was now placed upon the beach near high-water mark.

The *Great Lighthouſe* was a ſtrong octagon building of brick; and its light, alſo hoiſted on a *Swape*, was a naked coal fire, which, being unprotected from the wind, was ſubject to burn with very different and unequal luſtre: and it is related by the maſter of this Lighthouſe, that in the ſtorm of 1703 (when that of the *Edyſtone* was beat down) he "verily believed his tower (20 yards high) would have "been blown down; and the tempeſt made the fire in it burn ſo vehemently, that it melted down the iron bars on which it was laid, "like *Lead*: ſo that they were forced, when the fire was by this means almoſt extinguiſhed, to put in new bars, and kindle the fire afreſh." The *Storm*, p. 227.

318. IN

318. IN the autumn following I received from CHARLES WILDBORE, Eſq. *Secretary* of the *Trinity board*, the *Corporations* directions concerning the *Spurn Lights*, as follow:

The Situation, Heights, Dimenſions, &c. of the new Lighthouſes *and* Temporary Lights *to be erected at the* SPURN POINT; *as agreed on at a* General Court *of the* Corporation *of* TRINITY HOUSE, *held 12th July*, 1765; viz.

The lights to be in a N. W. and S. E. direction; and to be 300 yards aſunder.

The great Lighthouſe to be placed on the Spurn Point, at a diſtance from high-water mark (at common ſpring-tides) of 90 yards, in a N. E. and S. W. line; and 150 yards in a N. W. line, within the *Spurn*.

The ſmall Lighthouſe to be 116 yards diſtant from high-water mark in a S. E. line, without the Spurn.

N. B. The breadth of the land from ſea to ſea, in a N. W. and S. E. line, is 566 yards; and the ſoil is the ſame as in other places, where the ſand grows up from the ſea; viz. gravel mixed with ſand, and a moderate quantity of ſhingle.

The Lighthouſes to be built with *Brick:* the large one to be 90 feet high, from the mean ſurface of the ground to the center of the light.——The ſmall one to be 50 feet high; that is, 40 feet lower than the other: both with *incloſed Lanterns* for *Fire Lights*.

The two *Temporary Lights* to be placed in the ſame direction as before mentioned; 250 yards aſunder; and to be 23 yards to the S. W. of the ground marked out for the Lighthouſes.

The Great Temporary Light to be 50 feet high
The ſmall one - - - - 35 feet high } both with *Swapes* for coal fires.

It will be neceſſary to have a platform from one light to the other, for the men to walk on in the nights; about three feet wide, with a rail on each ſide *.

319. THE beginning of the enſuing year I produced to the Board a ſet of *Deſigns* for the erection of the two Lighthouſes; and of two temporary *Light Machines*, conformable to the foregoing directions; and eſtimates for the ſame: which being conſidered by the Board, were approved, and paſſed the *common ſeal* of the Corporation, the 21ſt February 1767. Thoſe being afterwards delivered to LEONARD THOMPSON, Eſq. he proceeded to the execution thereof; and in the courſe of that ſeaſon, built two *Temporary* Light *Machines*, according to the deſigns †; as alſo dwelling-houſes, and conveniences for the reſidence of the light-keepers: which being lighted, according to due notice given, were found to anſwer the end ſo completely, in point of ſituation, height, and conſtruction, that the trade ſeemed entirely ſatisfied therewith.

The temporary lights being thus eſtabliſhed, and Mr. THOMPSON finding difficulties in getting a contract for the erection of the *Lighthouſes*, two years elapſed without further progreſs; after which, in virtue of a *Proviſo* in the ſaid act, the *Corporation* of TRINITY HOUSE, *Deptford Strond*, became entitled to execute the further purpoſes thereof; and to this being alſo requeſted by Mr. THOMPSON, advertiſements for contractors were put forth; and at a meeting of the Corporation, of the 7th April 1770, Mr. WILLIAM TAYLOR, of *York*, appearing to be the loweſt propoſer, was declared the *Contractor*; and afterwards articles of agreement were entered into in conſequence.

320. THE 6th of May 1771, I had the honour to be appointed, by writing under the *Common Seal* of this *Corporation*, to be their *Surveyor*; for them, and in their behalf to *ſuperintend, inſpect, order*, and *direct* the execution of the works contracted to be done by the ſaid WILLIAM TAYLOR, in ſuch manner as I ſhould ſee moſt conducive to anſwer the end propoſed. In conſequence of this appointment I viſited the *Spurn Point* the following month, when Mr. TAYLOR had got together materials; but not having begun, it appeared to me, that ſince the year 1766, the ſea had ſo far encroached upon the eaſtern coaſt of the *Spurn Point*, that the very place fixed for the *Low Lighthouſe*, at 116 yards within high-water mark, according to the line of direction, was now in the very high-water mark itſelf. (See Plate 20, Fig. 2.) I

* The above reſolutions, as well as what precedes, will be fully explained by the literary references to Plates N°s 19, and 20.

† Plate N° 23, Fig. 2d, ſhews the elevation of the great temporary *Light Machine*. In its original ſtate, its baſe was ſunk into the ground, to keep it ſteady; but it is here ſhewn ſet upon walls, as it now ſerves for the *Low Light*.

therefore

therefore ſuggeſted to the Board, that it would be proper to ſhift the place of the Low Lighthouſe, as they had marked it out, ſo as to be 80 yards more *inland*; or to N. W.: which alteration being approved, Mr. TAYLOR began the foundation accordingly.——And furthermore, as it was poſſible the ſea might in proceſs of time make an attack upon *this building*, I directed Mr. TAYLOR to drive as many piles under the outward circle of its baſe, as ſhould bring them *cloſe together*, and to drive them as deep as they could be got into this ſand; which on trial was found to be about 9 feet *.

The 23d July the piling of this foundation was finiſhed, and the brick work begun; but the Contractor had ſcarcely got the work up to the level of the ground, before he was interrupted by an attack from the *agents* of Mr. ANGELL; which ſhewed the neceſſity of an *amendment* in the *act*: the obtaining of which ſtopped the works for above a twelvemonth. The latter end, however, of the year 1772, the foundation of the High Light was begun: and, by the approbation of the Board, it was placed 60 yards more towards the N. W. than originally intended, to make up in part for the 80 yards we had given up upon the S. E. ſide. I did not think it prudent to take the whole 80 yards; becauſe, though the N. W. coaſt had apparently *gained*, it did not appear certain, how much or how long it might continue ſo to do. The diſtance of the houſes, therefore, as now ſettled, was 280 yards.

The beginning of February 1773, the foundation for the *High Light* was completed: and in December following, the Low Lighthouſe was covered in; and the High Light got 40 feet high.

321. TILL my viſit in June 1771, I never had gone to the Spurn Point by land; in conſequence I had had no opportunity of remarking that the ſea was incroaching upon the *whole Coaſt*, quite from *Bridlington* to the high grounds at *Kilnſey*. I then ſaw the coaſt was in a ſtate of wear, but it was not till my viſits in the year 1774, that there had been a ſufficient interval, to aſcertain the rate, at which the ſea was annually waſhing away the high *clay* cliffs of *Kilnſey*: which, as near as I could then eſtimate it, was at the rate of 10 yards a year.——As the Low Light was then *erected*, the information naturally drawn from this obſervation came *too late*; for though I perceived that, as had been ſuggeſted in the year 1766, the *Point* of the *Spurn* was *increaſing*, yet it was chiefly in *length*. I now found that the high-water mark was not in reality more than 40 yards from the center of the Low Light; I therefore concluded it could not be many years before an attack *muſt* be made upon the Low Lighthouſe; but, as I had for ſome time conſidered the Spurn Point as an *appendage* to the high cliffs of *Kilnſey*; and formed from the waſte of the lands to the North; therefore, at whatever rate the ſea encroached upon theſe cliffs, by taking off parallel *Screeds*, this whole *appendage of the Spurn* muſt remove at an equal rate *weſtward*, upon the *average*. It, however, might alter ſome years more, others leſs, according to the caſual influence of ſtorms.

322. ACCORDINGLY, a great ſtorm happening in January 1776, took away ſo much of the S. E. coaſt in general, that it not only took away entirely the *ſite* of the old Lighthouſe; but firſt laid bare the circular *Court wall* of the *Low Light*; and then taking away the ſand below its foundation, beat down one half of its circumference in a ſingle tide; and ceaſed not till it had laid bare the *cloſe piling* under the circumference of the main building, driven for its protection. (§ 320.)

On viſiting Spurn Point on this occaſion, I ordered down a quantity of *Hazlecliff* ſtone† to be depoſited, ſo as to form a *ſloping Bank* or *Bulwark* at the foot of the building, to break off the fury of the ſea, till the ſeaſon ſhould come on when ſomething more effectual might be done; and left the further progreſs and application of the ſame means to Mr. TAYLOR, who had conſtantly reſided upon the place.

323. IN reflecting upon the obſervations I had made, and have already ſtated; I plainly perceived, that to defend this building againſt the future attacks of the ſea, nothing leſs could avail than what would

* The *deſign* of the Lower Lighthouſe, was perfectly ſimilar to that of the Great Light, in reſpect to the *Lantern* and *Pipe Room*; but the Body of the Light itſelf being *leſs*, the diameter of the lantern, and all below, to its baſe, were proportionably leſs: ſo that being 40 feet lower than the other was intended, it conſiſted of fewer rooms in height; viz. a *Coal Vault*, in the baſe ſtory, a *Dwelling Room*, *Pipe Room*, and *Lantern*.

† A kind of hard chalk-ſtone, got near the *Humber* ſide, above *Hull*, and much uſed in this country for all kinds of rough works, and defences againſt the waters.

defend

defend it as an *Iſland* at low water: this, though not impoſſible, would be ſo expenſive, as greatly to exceed that of rebuilding it, as often as it ſhould be beat down. I therefore adviſed the Board not to enter into any *formidable Expenditure*, but to give the injured parts a repair or re-eſtabliſhment, at the moſt moderate charge, that was likely to give the building a chance of its anſwering the end for which it was built, for a number of years: and, in this view, to rebuild the wall of a greater thickneſs; and *found* it as deep into the ſand, as it could *well* be got at a *moderate* expence; and then to fill the cavity between the wall and the houſe with *Hazlecliff* ſtone. Laſtly, to form a ſloping *Bulwark* of the ſame ſtone, againſt the outſide of the new wall: after this, with ſuch palliative aids, as prudence ſhould from time to time direct, to let it take its chance, to laſt as long as it could: and, at any rate, to ſet up the preſent *temporary high light machine*, in the line of *direction*; as ſoon as it ſhould be done with where it ſtood, by the lighting of the houſes. In this caſe, it might be applied as a *low light*, on an hour's notice; that is, as ſoon as any accident to the preſent *Low Light Building* ſhould make it neceſſary. This advice and opinion being approved by the Board, the ſame was put in execution, in the courſe of the following ſeaſon.

324. THIS accident did not, however, materially delay the progreſs of the work towards the lighting of the houſes; for at that time the Great Lighthouſe was covered in, the windows of the Lantern glazed, the *Hearth* ſet, and the balcony rails in their places: ſo that whilſt the interior works were proceeding, Mr. TAYLOR was employing other hands to rebuild and defend the wall as propoſed.

325. IT being the anxious deſire of the Corporations, and of the trade in general, that the houſes ſhould be lighted before the enſuing winter, I thought it my duty not only to forward this, but to give the Board the information, that from local ſituation I was able.——That in various parts of the *Weſt Riding* of *Yorkſhire*, there was dug a coal, of the ſpecies of the *Lancaſhire Kennel*, called here *Stone coal*, or *Cracklers*; which burns with a brighter and whiter blaze, than the ſtrong coal of *Newcaſtle* and *Sunderland* *, and therefore, it ſeemed to me, would be better adapted to the purpoſe of producing a light, and could be had at as low, if not a lower, price. The Board were pleaſed to order me to procure ſuch cargoes of *Stone coal*, as might be ſufficient for a full trial thereof, and which accordingly were procured.

326. UPON the 5th September 1776, the fires were kindled with *Stone Coal*, which exhibited an amazing light, to the entire ſatisfaction of all beholders.

As ſoon as the houſes were lighted, I immediately ordered the temporary High Light Machine, which I found ſound and firm, to be ſet upon the walls, that had been built in the direction of the lights; its centre to be 30 yards nearer the Great Lighthouſe than the centre of the Low Light; ſo that its diſtance from the centre of the Great Light, would ſtill be 250 yards.——Theſe walls, though ordered to be built in length, ſo as to be only capable of taking the baſe of the machine; yet whenever it ſhould want moving the walls could be lengthened, and the machine being then got upon rollers, would readily be moved to its deſtined place.

327. DURING the following winter it was found that ſometimes on firſt lighting of the fires in an evening, the funnels of the Lanterns would not vent the ſmoke ſo faſt as it was produced by the fires, but it accumulated in the Lantern. The chimneys were then of the ſame material as the roof, viz. *Elland Edge Flag-Stone*. Being willing to leave every thing complete, and finding that they would be conſiderably enlarged by making them of copper plate; the experiment was firſt tried upon the Low Light, which fully anſwering the end, the High Light was ſerved in the ſame manner; and it is ſo ſhown in the ſection of this building, Plate N° 21.

On viſiting Spurn Point, the 7th April 1777, I certified to the Board, that the *Lighthouſes* at *Spurn Point*, together with the whole of the works contracted to be done by Mr. TAYLOR, were fully completed and finiſhed.——Upon this viſit I had the gratification to find, not only that the lights had given

* As the Spurn lights had hitherto been made by fires expoſed to the fury of the wind, they doubtleſs required a coal of the ſtrongeſt quality; but as theſe lights were now to be ſcreened by Glazed Lanterns, a coal that would more freely yield its light ſeemed better adapted.

the utmoſt ſatisfaction; but that the Court-wall of the Low Light, was likely to endure for *ſome time:* for though it had had ſuch ſhocks, that the light-keepers had felt the tremor in the lantern, yet it remained ſound and firm.

328. CONSIDERING the inconvenience that this place ſuffers for want of freſh water; and that it is likely more and more to become inhabited, on account of the numbers that come on ſhore from the ſhips, lying in the Humber as an harbour; on this viſit I directed Mr. TAYLOR to ſink a *well*, to try to obtain either freſh water, or that which was ſo far free from ſalts, as to anſwer all ſubordinate purpoſes; and to be had *in plenty:* for here, the tops and roofs of the buildings are ſo impregnated with ſalts from the ſpray of the ſea, that the rain-water collected from the drippings thereof, is ſeldom without a very ſenſible impregnation. The experiment was not likely to be an expenſive one, and was ordered in virtue of an obſervation that had occurred in the courſe of the work.

Mr. TAYLOR being at liberty to uſe ſea water for wetting his mortar, ſunk a well near to each Light-houſe, when he began them; merely to obtain ſalt water *more eaſily*, than by fetching it from the ſea at low water; but was much ſurpriſed to find, that the water ſo obtained was but merely *brackiſh*, and that in all ſtates of the tide. On examining this circumſtance myſelf, I found further, that the height of the water in the well remained nearly the ſame, that is, at about the *half-tide* mark. That at the high water of a ſpring-tide, when the water flowed within the diſtance of 20 or 30 yards of the top of the well, the water in the well neither roſe ſenſibly higher, nor was it, to common obſervation, more brackiſh; though there was nothing to hold off the ſea, but a great maſs of porous ſand: and on the other hand, when the ſea retreated 150 or 200 yards, the water of the well during the time of low water became ſcarce ſenſibly more empty, nor did it grow ſenſibly more freſh.——Reflecting on the cauſe of this unexpected fact; it appeared to me, that whatever rains or ſnows fall upon the ſurface of the Spurn, conſiſting of about 98 acres, it all ſinks into the ground, and therefore muſt make its way to ſea by percolation through the pores of the ſand; and in its paſſage it will by degrees waſh off the ſalts adhering to the ſurface of the particles of ſand at their firſt depoſition: in conſequence, this happening repeatedly, the internal part of the *Peninſula*, which being ſuppoſed to have been the longeſt formed, muſt have had the greateſt length of time to have its ſalts waſhed off by the freſh water of the rains, would of courſe afford the freſheſt water when ſunk *into*, deep enough to pierce the *water bed*; and which probably would lie upon an higher level there, than near the border, on account of the neceſſary declivity for the paſſage of the water by percolation to ſeaward.——In conſequence of theſe ſpeculations, I ordered a *well* to be ſunk near the middle of the peninſula; and had the ſatisfaction to hear, that it anſwered expectation, being but *barely brackiſh*; for that cattle would drink it, and it ſerved every purpoſe of a family, except for human drinking, and waſhing of linen: nor could it be expected to be perfectly freſh, as the very rain muſt frequently have a conſiderable admixture with the ſpray of the ſea.——It appears then, that though a great maſs of ſand does not hinder a ſlow progreſſive motion by *percolation*, yet it reſiſts all great impulſes, to ſuch a degree, that, in the ſpace of a tide, the ſalt water has not time to make much progreſs in return. *Attraction* of *Coheſion*, therefore, between the particles of ſand and water, ſeems to perform the office of a *Stop-gate*, which ſuffers the eſcape of the water to ſea at a *medium height*; and, by preventing its ſpeedy return, ſuffers the downfall waters (like thoſe of a tract of country under artificial drainage by ſluices) to have a progreſſive motion from the internal parts towards their outfall *.

329. BEING upon a journey to *Hull*, the 5th October 1786, I went from thence to viſit the *Spurn*, and had the ſatisfaction to find every thing in order, and completely anſwering their purpoſe †.——

On

* Had Sir THO' HYDE PAGE been acquainted with what had here been done; it ſeems as if it would have led to an explanation of what he experienced at *Landguard Fort* in the year 1782: where he found that *good water* was produced by digging into a ſand at eight feet deep, and continued in great plenty to 12 feet deep; but by forcing the well down to 18 feet deep, the water that iſſued from the bottom became *entirely Salt*. See his account *Philoſ. Tranſact.* vol. lxxiv. p. 16.

† I muſt however except the *well*; the water of which, it was my intention to have examined; and I had taken with me ſuch materials as my chemical friends adviſed, to have aſcertained the quantity of admixture of ſea ſalt in this water. But I was defeated in my intention

On this occaſion I took a *Survey* of the *Spurn Point*, and Plate N° 20, Fig. 1ſt, is the plan deduced from thence; from whence it appears, that the foundation of the old Lighthouſe, which was wholly within the unbroken land in the year 1771, was now 50 yards without the preſent border towards low-water mark: not the leaſt veſtige of it being to be ſeen. It was, therefore, by the united teſtimony of the *reſcients*, who referred to marks, that I was enabled to aſcertain its place. In the year 1771, the land where it then ſtood had a conſiderable breadth, but now it lies oppoſite to the narrow *Iſthmus*, which, after extending about a quarter of a mile to the N. Eaſtward of this ſite, becomes a naked *beach* or ridge; over which the ſea breaks into the *Humber*, at high-water, in rough weather, with eaſterly winds, at ſpring-tides; and after running about half a mile in that form, attaches itſelf to a prominence of the main land, from *Kilnſey*; which was probably the *Spurn* HEAD of CAMDEN.——This beach or ridge I found to have nearly the ſame appearance in 1786, that it had in 1771; only, it ſeemed to have grown longer, by encroaching ſouthwards, upon the flat area of the Spurn Point *.

330. ON this viſit, the original temporary light great machine was now in actual uſe; the Low *Lighthouſe* having been for ſome time demoliſhed, and, at this time, not the leaſt trace left of its foundation †.

331. IN departing from the Spurn this laſt viſit, I was ſtruck with an appearance that I can ſcarcely ſatisfactorily account for. I did not leave the Spurn till ſome time after the Lights were kindled. The Low Light, though in itſelf a fire of much leſs bulk than that of the High Light, yet, at this diſtance, being *now* a naked light, without the interpoſition of glaſs, appeared more vivid and brilliant than the High Light. When I got about three miles off, near *Kilnſey*, they ſeemed nearly equal; but when I got to *Patrington*, nine miles off in a ſtraight line, the luſtre of the High Light was greatly ſuperior: in this I could not well be deceived; becauſe, in obſerving them for a conſiderable time when the fires were in different ſtates, the brightneſs of the High Light when fainteſt conſiderably exceeded that of the Low Light when brighteſt: now the query is; If the glaſs diminiſhed the luſtre of the light in a ſenſible degree (as it muſt be expected) when *near*, why ſhould it not do it *proportionably* at every other diſtance?

332. I HAD the great ſatisfaction to find at *Hull*, that the *Spurn Lights* were in ſuch credit among the *Seamen*, that they were by them eſteemed (on account of their clear and brilliant light) to be the beſt Lights in *Europe*.——It is ſaid that veſſels going round the *Point*, in a *dark night*, have the ſhades of their maſts and ropes caſt upon their decks: that veſſels ſailing northward gain ſight of the *Spurn* before they loſe ſight of the *floating Light* of the *Dodgeon*, which lies off the great *Lincolnſhire Waſh*; and that frequently, the Great Light of the *Spurn* has been ſeen, in clear weather, from the high grounds near *Beverley*, which is a diſtance of 30 miles.

333. I SHALL cloſe this account by an explanation of the principle whereon the *Air-draught* of this Lighthouſe is performed: which, as I apprehend it is ſomewhat new, and ſucceeds well, the curious artiſt may not think undeſerving of his notice.

tion and mortified, by finding that it was filled by bricks and rubbiſh, ſo that at eight feet deep, there was no water.—I was told, that as it was appurtenant to no one's tenement, and at a diſtance from them all; idle miſchievous people, who frequently come on ſhore to ſaunter about, had amuſed themſelves by throwing things into the water, to judge of its depth, till they had reduced it to that ſtate: and as it was no one's buſineſs to clear it, each was willing to ſhift for himſelf; though all agreed it had been very uſeful.

* This Beach or Ridge has in its appearance ſome ſimilarity with that of *Portland*; and, if I miſtake not, it is formed, underneath the ſand, of *blue clay*, ſuch as the cliffs of *Kilnſey*.

† I found on enquiry, that after a repetition of ſtorms, the Court-wall had given way, and an ineffectual attempt had been made to repair it. The main body of the building was ſoon after attacked; but it ſtood without the leaſt crack or appearance of ſettlement, till ſucceſſive gales had proceeded ſo far as to take away ſeveral of the piles in the *Circumference* of the baſe; inſomuch, that, (according to their expreſſion) an *Heifer* might have been drove under it, among the piles: but after remaining ſome time in that condition, in one ſingle rough tide, it came down all at once, and the materials were in a great meaſure diſſipated and buried in the ſand. The *Machine* had then been ſome time in uſe.

The

The air being rendered ſpecifically lighter by the heat of a fire; if from thence it is introduced into a tube or *funnel* while in its heated ſtate, the abſolute gravity of this column is juſt ſo much lighter than a column of the external air of equal height, as is due to their difference of ſpecific gravity: and this difference of abſolute weight of the two columns, is a poſitive power by which the lighter one endeavours to aſcend up the tube, according to the laws of *Hydroſtatics*.——Now, if the air that is required to repleniſh the tube at the bottom, to fill up in *lieu* of what has aſcended, cannot enter it without paſſing through, or ſo near, a body of fire that it becomes heated thereby, this alſo becomes ſucceſſively rarefied; and thus a conſtant power, or *Draught* of air is generated.——This I look upon to be the common principle upon which the draught of chimneys and Furnaces depends: the tube of rarefied air being placed *above* the fire.

In this Lighthouſe the principle of *Air-draught*, or tube of rarefied air, is *below* the fire: for as the fire muſt of neceſſity be expoſed to full view, all round; being in a capacious Lantern the draught is cut off, or interrupted, above the fire; ſo that the funnel of the Lantern muſt be wide enough to vent all the ſmoke that is ſent up, as we have ſeen, § 327. In this conſtruction the *receptacle* for the cinders, being a large tube, over the top of which the fire-grate lies, no air can paſs through the fire-grate into the fire, but what comes from the receptacle; the air of which being heated by the cinders, that fall through the grate, has a tendency to aſcend, upon the ſame principle of rarefaction.——This receptacle is ſupplied by horizontal air-pipes, from the external air: and, that its operation may not be impeded by, but rather receive advantage from the wind; in every direction; the pipes, which are eight in number, are regularly diſpoſed with reſpect to the *compaſs*; and each has a ſlider to ſhut up ſuch as would be otherwiſe a diſadvantage. A further explanation of theſe matters will be found in the technical deſcription of Plate N° 21.

TECHNICAL REFERENCES TO THE PLATES.

THE VIGNETTE. *The* MORNING *after a* STORM, at S. W.

THE *Vignette*, as being placed in the title page, on that account claims priority: but in order of deſcription would have come in more naturally in a ſubſequent place. The intent of it is to give ſome idea of the nature of this ſituation in a ſtorm, and the violence of the ſeas upon this ſpot. The extraordinary ſwelling of the wave on the left hand, above the letter A, is doubtleſs owing to the gradual ſloping of the rocks underneath it, as will be more particularly explained in the ſubſequent *Plates*.——The wonderful riſing of the water, at B, by the ſtroke of it upon the building, which for the inſtant totally hides it from the eye, is certainly beyond what might be expected, or perhaps readily accounted for, from the reſiſtance of a round column; yet concurrent teſtimony from Mr. WINSTANLEY's deſcriptions (§ 17 and 21.) down to the preſent time leave no doubt of the height. This ſketch thereof, ſo far from being exaggerated is much reduced, both in height and bulk, in order that the idea of a building contained therein may preſent itſelf.——The *gathering* of the ſea at C is a natural conſequence of its being taken up by the ſouth *Reef* of rocks, which are fully deſcribed, Plate N° 3, to which I refer: as alſo to the Deſcription, § 301.

PLATE, N° 1. *A* GENERAL CHART *of the* SEAS *ſurrounding the* EDYSTONE LIGHTHOUSE.

The ſituation of the Lighthouſe in the chart will indicate its expoſure: for, if we ſuppoſe a line drawn from the point A upon the coaſt of *France*, to the *Lizard Point*, the diſtance being about 31 leagues, which may be eſteemed the width of the mouth of the *Britiſh Channel*, the *Edyſtone* will be found to lie only 15 leagues within this line; that is, leſs than half the width; and being expoſed to all winds from about S. by W. to W. by S. there will be nothing to hinder the *Ground-Swells* of the *Bay of Biſcay* and of the *Atlantic Ocean* from coming home upon the Edyſtone Rocks uncontrouled, and even magnified, from the gradual leſſening of the ſoundings. See § 5 and 6.

PLATE, N° 2. MAP *of the* COASTS *and* COUNTRY *oppoſite the* EDYSTONE ROCKS.

This Map ſhews the general ſituation, and particular diſtances of the Edyſtone Rocks from the neareſt part of the coaſts of *Cornwall* and *Devonſhire*. The diſtance of the port of *Plymouth* being 14 miles, the *Mewſtone* or *Mayſtone* 111, and the *Ram Head*, or perhaps more properly *Rame-head*, ſomewhat under 10.

PLATE, N° 3. *A* GENERAL PLAN *of the* EDYSTONE ROCKS, *as ſeen at low Water of a Spring Tide, comprehending every Thing liable to damage a Ship.*

From this Plan it appears from the ſoundings at low water, that the largeſt ſhips may ſail between the ſouth and the ſouth-eaſt *Reef*, upon a courſe between N. and N. N. E. or S. and S. S. W. by the compaſs, according to its preſent variation of two points weſt nearly; that is, in caſe of being inadvertently entangled; here being a clear width of 20 fathoms: but a veſſel ſailing up or down Channel upon any courſe from W. N. W. to N. W. by W. or the contrary; and giving the Lighthouſe a clear *birth* of 50 fathoms to the ſouthward, will be clear of the north end of the South Reef, full 30 fathoms, on one hand, and of the N. E. Rock as much on the other; in ſoundings of about 10 fathom; and thus, a veſſel of any ſize, in moderate weather, may ſafely ſail within 50 fathoms of the Lighthouſe: but upon a S. W. or N. E. courſe, leaving the houſe on the eaſt, ſhe may ſafely paſs by the building at half that diſtance.

PLATE, N° 4. *South* ELEVATION *of the* ORIGINAL LIGHTHOUSE, *built upon the* EDYSTONE ROCK, *according to the firſt Deſign of* WINSTANLEY. *Taken from a perſpective Print drawn at the Rock by* JEAZIELL JOHNSTON, Painter.

A An *Eye Bolt* at the *Landing-place* for faſtening the Boats.——B The *ſloping ſurface of* the rock.——C The Foundation or *Baſement*, ſuppoſed to be of *ſtone*; and the horizontal joints of the courſes, to be bound round with *hoops of iron* or *copper*.——D The *Store Room*.——E The *State Room* (ſo called in the original) ſuppoſed alſo to ſerve as a lodging room.

F The *open Gallery* for looking out in fine weather, and ſuppoſed intended to let the ſeas go through in ſtorms.——G The *Kitchen*; ſuppoſed alſo to be uſed for lodging.——H The *Lantern*, about 8 feet diameter, corner and corner, and 7 feet high. N. B. The ornamental iron work appears to riſe near 18 feet above the uſeful part of the roof. See § 20.

PLATE, N° 5. *South* ELEVATION *of* WINSTANLEY's LIGHTHOUSE *upon the* EDYSTONE ROCK, *as it was finiſhed in the Year* 1699. *Drawn* orthographically *from a* perſpective *Print thereof, publiſhed by himſelf.*

A Repreſents the *Rock* at low water.——B The *Landing-place*, covered at half tide; and all the time the current runs eaſtward.

C The *Entry Door*.——DE The *Baſement*; which, in the fourth year's work, he deſcribes to have been added to the original one of 16 feet; ſo as to make an addition of four feet in thickneſs on every ſide. From the figure it ſeems, that on the weſt ſide at D, it has been a work of ſtone; the joints appearing to have been covered with *hoop plates*, as before deſcribed of the original baſe; whereas the eaſt ſide E has the appearance of having been *wood*; and to have been bound together with *iron ſtraps*, as the whole of the ſuperſtructure evidently was.

F Is the *Store Room*, with a projecting cabin to the ſouth-eaſt.——G The *State Room*.——H The Kitchen.——I The open Gallery, or Platform.——K The *Lodging Room*.——L The attending or *Look-out* Room.

M The *Lantern* for the lights, ſurrounded by a Gallery or *Balcony*.——N The *Flag* uſed for making *Signals*.

PLATE, N° 6. *South* ELEVATION *and* SECTION *of* RUDYERD's LIGHTHOUSE, *completed in* 1709. *Repreſented as it ſtood previous to its* Demolition *by* Fire, *in the Year* 1755.

A Shews the *Rock* at low water of a ſpring tide.——B The *Landing-place*.

a a The *Steps* or Flats to which the rock was reduced. *b b* The *Branches*. *c c*, &c. Floors of wood laid *lengthwiſe* of the ſtepe. *d d* Floors laid *croſswiſe* of the ſame. *e e* Courſes of *Compoſs Timber*.

D Five courſes of Moorſtone; which, with two courſes of wood marked E, completed the *entire* ſolid. To the top of which lad

F The *Iron Ladder*, to G the *Entry Door*, and through G H the Entry or Paſſage, into H I the *Well-hole* for the ſtaircaſe.

K L The *Maſt*.——M Five courſes of Moorſtone, the height of which compoſed the entry or paſſage.——N Two beds of *Compoſs Timber*, making all good over the entry.

O Four beds of Moorſtone covered with two beds of Compoſs Timber; after which ſucceeded courſes of Timber alternately, *croſs* and *croſs*, with compoſs courſes interpoſed, as ſhewn in the ſection.

P Q Shew the upright timbers, or *Uprights*, as they appeared externally, being 71 in number.——*p q* the ſame in the ſection.

I I The *Store Room* Floor; and R the Door of the Store Room; which was ſo much to the north of the entry, that when the caſks and ſtores were hoiſted up perpendicularly by a tackle, ſuſpended from above, they would clear the iron ladder.

S The *State Room*.——T The *Bed-chamber*.——U The *Kitchen*.——W The *Balcony*.——X The *Lantern*.——Y The Lantern Door into the balcony.——Z The *Cupola* and Ball.

f Four curved Pipes for venting the ſmoke from the candles in the lantern.——*g* The top of the copper *Funnel* which paſſed through the lantern, from the kitchen fire place, which was of brick.

h The upper *Kant*, bevil, or *projection* of the cornice, for throwing off the ſea, to prevent it from breaking the windows in time of ſtorms: which was neceſſary, though the panes were of *ground glaſs*, on account of ſtrength.

i i Knees to ſtrengthen the junction of the *uprights* with the balcony floor, and alſo in part to ſupport the weight of the lantern.

k k k The original *Kirbs* of compaſs timbers, to form the uprights to a circle, and ſupport the weight of the floors.——*m m m Kirbs* applied, of late years, for ſtrengthening the frame of the building.

n n The lower *Kant* at the foot of the uprights; and *o* one of the *Stanchions* by which the kants were faſtened down.

p The place where a part of one of *Winſtanley*'s chairs was jammed ſo faſt, on the deſtruction of that building, that it there remained, and was ſhewn as a curioſity of the place, during the time of the ſucceeding ſtructure.

q The natural Cave into which the lightkeepers retreated when the houſe was in flames.

N. B. The *technical references* to plates N° 4, N° 5, and N° 6, were inſerted in the body of the work; which the author thought it right no longer to encumber therewith; but are here inſerted, to preſerve the regularity of this part of the work.

The detached figure 2. ſhews the manner of joining the five courſes of ſtone marked D (fig. 1ſt.) wherein K ſhews the *Maſt*, and *a a* the places of 8 upright Bats; *b b* being ſuppoſed two more of the ſame nature. The black lines ſhew the joints of the firſt courſe; the dotted lines thoſe of the ſecond; and ſo alternately.

Fig. 3. Repreſents the manner in which the courſes of the bed of Moorſtone M (in fig. 1ſt) was jointed; wherein K is the *Maſt*; *a b c d* the *Well-hole*, and *e f g h* the *Entry* from the *Iron Ladder* into it. The jointing of the courſes in

this bed alſo, were alternately, according to the black and the dotted lines.—— This figure may alſo ſerve to deſcribe the courſes of the bed of Moorſtone O, if the paſſage is ſuppoſed, omitted.

PLATE, N° 7. *A* PLAN *and* perſpective ELEVATION *of the EDYSTONE ROCK, as ſeen from the Weſt. Taken from the* Model *thereof,* § 81, 105. *Shewing alſo the* THEODELITE.

The repreſentation is as I found the rock; *Fig.* 1. being the *Plan*, and *Fig.* 2. the *upright* View. The ſame Letters refer to the ſame parts in both; the *croſs Lines* upon the plan anſwer to the *Cardinal Points*, E. W. N. S. according to the true meridian.

L is the *Landing-place*, and C the *Summit* of the Rock; the general declivity being towards the S. W. the *grain of the laminated* moorſtone that compoſes it being nearly parallel thereto. It has, however, conſiderable irregularities: for upon the line AB the Rock makes a *ſudden dreſs* of 4½ or 5 feet (§ 7.) and by over-hanging to the weſtward, when there is a *ground ſwell* at S. W. the ſudden check cauſes the ſea to fly in an aſtoniſhing manner, even in moderate weather.

The Surface of the Rock is ſhewn, as ſuppoſed to have been for ages paſt; except where it is viſibly altered by man's hand, chiefly within the circular area of the late building. The flat *Treads* of the ſteps cut by *Rudyerd* are marked D; the upright Faces of the ſteps F; and E denotes the *ſpeckled* parts, parallel to the grain of the Rock.

a b c d e f g h ſhew the remains of the cavities of eight of the 12 great irons fixed by *Winſtanley*, of which the ſtump of one only, viz. that at *a*, remained for my inſpection; it was run in with lead, and had continued faſt, till in planting a dove-tail there, it was cut out and found *club-ended*; ſee § 39. Which of the other holes, that are left unmarked, made up the remaining four, I could not make out; as doubtleſs ſeveral of them appertained to the additional work that he fixed in the 4th year (§ 21).

Fig. 3. ſhews a pair of Rudyerd's iron *braciles* (§ 36, 39) to a ſcale three times larger than that of the plan; wherein AB is the *main branch*, or *dove-tail* part; CD the *Key*, driven hard in, but without touching the bottom; their depth in the rock is denoted by ſuppoſing the line EF its *ſurface*. The holes in the branches ſerved to faſten the timbers, by large bearded *pike bolts*.——Of thoſe branches I traced 36 original pairs, of different ſizes; and two more modern: their places are ſhewn in the upright, *Fig.* 2. by inſpection; and likewiſe in the plan, *Fig.* 1. at 1, 2, 3, 4, 5, and 6, 7, 8, 9, 10, &c. forming a double circle; alſo two pair of them at K to fix the mall, or two ſides, to the center. The irons that remained in the rock, are diſtinguiſhed in the plan by being hatched with *fine* lines, the empty holes or cavities by being black. Thoſe that remained whole, whether faſt or looſe, are diſtinguiſhed in *Fig.* 2. by their ſhapes.

X Shews the place of the *Cave* on the eaſt ſide; and R a ſtrong *Ring Bolt*, put into the Rock on the recommencement of the building in 1757, for faſtening the weſtern *guy-chain* of the *ſheers*.

In *Fig.* 2. *r i t v w* ſhews the *three-legged* ſtool (§ 81) ſtudded with *croſs bruces*. Upon the middle of the upper round plank *r s* was ſcrewed down the *Theodolite* T, to whoſe *Index* was ſcrewed the long *horizontal Rule* T S, divided into feet, inches, and parts upon one edge, tending to the center.——Upon any marked point of the Rock to be aſcertained, ſuppoſe *x*, the rod *x y* was ſet upright by a *ſpirit level*, and was preſerved in an upright poſition by two ſmall ſlips of deal, applied as *ſtays* or *ſtruts*, in two different directions. The divided *edge* of the rule, being brought againſt the upright rod, was ſhoved up by a ſhort ſtaff, held in the hand tight againſt the rod, till a *ſpirit level* laid upon the top of the rule, ſhewed it to be level. In this poſition the index would ſhew the degree and minute of the circle; the upright rod would mark the diſtance from the center upon the rule; and the rule would mark upon the rod, how much the interſection was above its bottom at *x*; ſee § 81.

PLATE, N° 8. *South* ELEVATION *of the* STONE LIGHT-HOUSE *compleated upon the EDYSTONE in* 1759. *Shewing a Proſpect of the neareſt Land, as it appears from the Rock in a clear calm Day.*

A The *Landing-place*.——B The *Cave* in the eaſt ſide of the Rock.—— C The *Steps* cut to mount the Rock to the entry door.—— D An Iron Rod, ſerving as a *Roll* to hold by, in paſſing to the foot of the ladder, occaſionally put out from the *Entry Door* at E.

Over the letter F is a view of the land about *Whitſun-Bay*.——Over G the *Ram-Head*.——Over H *Rudding-Point*.——I St. *Nicholas*, or *Drake's* Iſland.——K *Brentnore*.——L *Garriſon* of Plymouth.——M Plymouth Town.—— N Ships in *Plymouth Harbour*.——O Mount *Batten*.——P Ships in *Catwater*.—— Q *Statuonus* Point. N. B. The *Cascade* ſhewn to the left of F muſt be ſuppoſed momentary; and, from the libration of the water, the next moment to ſee the contrary way.

PLATE, N° 9. SECTION *of the EDYSTONE LIGHT-HOUSE upon the Eaſt and Weſt Line, as relative to* N° 8. *Suppoſing it the* LOW WATER *of a* SPRING TIDE.

In the ſection of the Rock, AB ſhews the upright Face or *Drop*, marked with the ſame letters in Plate N° 7. and the line BC ſhews the general direction of the *grain*, and ſlope of the Rock to ſouth-weſtward.

The dotted line *a b* ſhews the level of the baſe of the *firſt* ſtone. The black line *c d* is the baſe of the ſtone in the firſt *courſe* that is interſected by the E. and W. line; and *e f* is the level of the top of the 1ſt courſe, and *bed* of the 2d. 2, 3, 4, 5 and 6 mark relatively the tops of the ſix courſes that bring the artificial part of the foundation upon a level with the *reduced* top of the natural Rock; *e f* being the firſt entire courſe, marked VII. as being the ſeventh above the ground joint.——*f* Is the foot of the *temporary Ladder*; and there is ſhewn the manner in which the ground joint of the ſtone-work was ſunk into the Rock, all round, at leaſt three inches.——*b* Shews the firſt *marble Plug*, or central *Joggle*, that went through the 6th courſe, and reached half way through the 7th; and ſo on, in ſucceſſion to the top of Courſe XIV.

k l In like manner ſhew, the place of the marble *cubic Joggles* inlaid between each two courſes, which were in an octagon diſpoſition round the center.—— *l* Smaller cubes between the 5th and 6th courſe.

Courſe XIV. terminates the *entire ſolid*; as upon it is pitched the *entry* and *well-hole* for the ſtairs.——The temporary ladder *f g*, to the entry door D, is only put out when wanted; and then is lathed by eye-bolts to the ſtone; at other times, having a joint in the middle, it folds, and is laid along in the entry.

Above the top of the entire ſolid, the center ſtone being omitted to give ſpace for the Well, the cubic joggles were of double the number, and half the ſize.——Courſe XXIV. terminated that part of the building called *the Solid*: and here the habitable part of the building began, whereof E is the *lower* Store-room.——F The *Store-room Door*.——G The upper *Store-room*.——H The *Kitchen*.——I The *Fire-place*, from which the ſmoke aſcends through the floors and lantern, through a *copper funnel*, as per *ſection*, and through the *hall*.

K The *Bed Room*.——L The *Stone Baſement* of the *Lantern*.——M The *Lantern Door* into the *Balcony*, and N the *Cupola*.

The aſcent from room to room is by perforations through the middle or *Keyſtone* of every floor; and the detached figure ſhews the means, by inclined ſtep ladders, removable at pleaſure.

PLATE, N° 10. PLANS *of the* ROCK *after being cut, and prepared to receive the* STONE BUILDING. *Shewing the Six* FOUNDATION COURSES.

Fig. 1. Plan of the Rock, as prepared for the ſtone-work, ſomewhat extended to ſhew how it applies to the plate N° 7. The line AB ſhews alſo here the place where the ſurface drops, as ſpecified N° 9.

In this figure, *Courſe* I. appears in its place, as fixed with it's *Trenails* and *Wedges*, § 222, 223. The part darker ſhaded, and marked *D D*, was not reduced to a *dove-tail* on account of fiſſures, but was ſunk two inches lower than the reſt of *Courſe* II. The ſtones laid therein would therefore be encompaſſed by a border, and held faſt in every direction. The letters E. W. N. S. in all the figures denote the *Cardinal Points*; the ſame letters in every figure denoting the ſame parts.——The part of the Rock marked C, riſes above the reſt by an aſcent or ſtep of 15 to 18 inches, according to the line F D G E; which, laying ſome what without the general contour of the building, and affording a firm abutment, the advantage was taken; and the work of the 1ſt and 2d courſe carried againſt it, as ſhewn at G.

N° 1, 2, 3, 4, 5, 6 ſhew the level platforms, or *ſteps*, for the different courſes, whoſe upper ſides are even with thoſe numbers in *Section* N° 9. N° 2 being upon the level of *Rudyerd's* loweſt ſtep.——X denotes a piece of ſtone engrafted into the Rock; ſerving as a bridge to croſs a *Chaſm*, opened by cutting down the top of the Rock to that level, into the *Cave*. Out of this ſtone is formed a part of the border that encircles the work.

Fig. 2. ſhews how the buttreſs G was terminated in the 2d *courſe*. It alſo ſhews the places of the *Trenails* and *Wedges*; which in all theſe figures are ſhewn in the ſame manner. The *dotted* lines every where refer to the courſe that is to come on; and ſhews how it will *break joint* upon the courſe ſuppoſed laid.

Fig. 3. ſhews how the ſpace H I K, in *Fig.* 2. is filled up in *Fig.* 3. being confined in, by the riſe of the ſtep L at H I, and the *cramps a* and *b*; the ground proving here irregularly ſhattered by cutting the ſteps for the former Lighthouſe.

Fig. 4. ſhews the ſtructure of *Courſe* IV. where in this, as all the others, the ſtones lighter-coloured denote the *Portland*, the darker the *Aberſtone*.

Fig. 5. ſhews the poſition of three *joggle holes* Y, betwixt this courſe and the next above.

Fig. 6. ſhews *Courſe* VI. complete, which brings the whole work to a level with the reduced Rock: it ſhews the joggle *holes* for the eight cubes; and the central *plug joggle*, fixed in place at O, ready for the reception of the center ſtone of the next *Courſe* N° VII.

PLATE, N° 11. PLANS *of all the different* COURSES *from the Top of the* ROCK *to the Top of the* BALCONY FLOOR *incluſive.*

Fig. 1. is the proper plan of Courſe VII. relative to the Section, Plate N° 9. As being the firſt entire courſe, the trenails and wedges are ſhewn; but afterwards omitted in the draughts, to prevent crouding the figures. The black lines and dotted lines ſhew the joints of the alternate courſes. The center ſtones, and the four ſtones ſurrounding, were alternately of the ſame ſize to the top of Courſe XIV.——*a* is the center plug, firſt ſet: *b b* the ſquare part of the center ſtone; from each of whoſe four ſides a dove-tail projects, and thereon are fixed the four ſtones *c c*, by joint wedges and trenails, as per figure; which five ſtones united, make one ſtone, ſufficiently large to receive eight ſmaller dove-tail ſtones *d d*, and whoſe projecting parts form dove-tails to receive another circle, or order of ſtones, fixed like the former. The cubic joggles are ſhewn at *e e*.

Fig. 2. gives the plan of the XIVth *Courſe*, ending the *fundamental ſolid*, and on which the entry and well-hole are begun. It alſo ſhews the diminution from *Courſe* VII. Upon this figure is ſhewn the diſtribution of the ſmaller cubic joggles, which take place upon the *entire* ſolid. The entry here appears to have a ſmall *inclination* with the E. and W. line, which was not noticed in *Section*, N° 9, to avoid ambiguities.

Fig. 3. is the plan of Courſe XV. being the firſt of the entry door and *well* courſes.

Fig. 4. is the plan of *Courſe* XVIII. ſhewing the work of the entry cloſed in, and the ſolid reunited. Alſo the manner of *hook jointing* the four ſtones round the center to each other; which in the courſes below the entry door, were united

by

by dove-tails to the center ſtone. Joint wedges were applied in the hook, as *per figure*. Thus the arrangement, in circles from the center, was again complete. In the entry courſes, as every piece had at leaſt one cubic joggle and two trenails, the work was ſecure againſt all ordinary attacks of the ſea; the weakneſs being on the eaſt ſide: but when capped and bonded together by this XVIIIth *Courſe*, the whole was again conſidered as one *entire ſtone*, out of which the cavity had been cut.

Fig. 5. ſhews *Courſe* XXIII. ready for putting on the cap courſe of the ſolid.

Fig. 6. gives the *cap courſe*, making the *ſtore-room floor*, in its finiſhed ſtate; the firſt courſe of the habitable part of the building, viz. *Courſe* XXV. being upon it, and ſhewing the *ſtore-room door*, with its *joggles*, *joint ſtones*, and *cramps*.—— The detached figure, relative to it, ſhews a part of the top of the wall of *Courſe* XXV. to a triple ſcale; wherein *b b ii* denotes one of the pieces of ſtone, whereof 16 complete the circle: *f* ſhews one of the *joggles* uſed in this part of the building; being ſlices of marble the ſize of a *common brick*, let half its thickneſs into the middle of the ſtone; ſo that the next courſe above, breaking joint upon the middle of this, according to the dotted line *g g*, half the joggle's length will take one of the upper ſtones, whoſe joint comes upon it, and the other half joggle, the other: by which means every ſtone is fixed to its place, as it were, by *two ſteady pins*, one at each extreme. The black lines *h i* ſhewing the joint at each end of this ſtone; the ſmall *lozenge* figures *k* and *l* ſhew the ſhape of *grooves*, cut from the top to the bottom of each end of each ſtone, and which, when two are joined together, form that figure: *k* denotes the lozenge empty, or unfilled, and *l* the lozenge filled with a *joint ſtone*. See § 256, 257.——*m n* Shews the ſhape of one of the *cramps*, lie upright; and *o p* as ſeen upon the flat. The holes in the ſtones at *q r* are bored, to receive the round ſhanks of the cramp; and the rectangular cavities *q r* are ſunk, to bury the flat of the cramp *o p*.

Fig. 7. gives the plan of the *Kitchen Floor*, and the upper bed of *Courſe* XXIX. that encircles it; ſhewing one of the *endleſs chains*; of which, as appears in *Section* N°9. there are two to each floor. The *detached figure* ſhewing an enlargement of the chain, and groove that contains it, will need no comment, after peruſal of § 258.——In the *principal figure* the dotted lines at *t* ſhew the place of the *fire grate*; *v v* the *ſink*, *w w* the *dreſſer*; *x x* the *ſettle*; *y* a place for a *clean table*; leaving a vacancy to the window between each. § 287.

Fig. 8. is the plan of the *Bed-chamber*, taken upon the top of *Courſe* XLIII. which gives the horizontal ſections of the windows.——*y y* Shew the places of the three *cabin beds* for the lighthouſe-keepers, § *ibid.* *z* The hole in the floor for the *upper funnel* from the kitchen, and *w* ſhews the place of the *ſtack*.—— In the *detached figure*, *b b* ſhews how the cramps are diſpoſed in the *reduced ſcantle* of the windows. *c* Shews the plan of the *rabbet*, to receive the ſhutters or *parts* of the windows, whereof the uprights are ſeen in *Plate* N° 8 and 9. *d* Shews the *fill* of the clear opening; againſt the ſolid of which, the window frame *e f*, and ſaſhes are lodged; the whole of which go in together, and are held in by wooden pins, two above, and two below, as ſhown at *g g*; the holes being bored in the ſolid ſtone. If thoſe pins are cut off, the whole can be drawn out and renewed, without injury to the ſtone work. The joint of the wood frame with the ſtone work, is ſecured againſt wet by white lead and oil.

Fig. 9. ſhews the *plan* of the *Cap* of the *main Column*, being in *Plate* N° 9. the XLVIth *Courſe*, and compoſes the *Balcony Floor*. *b b* Shews the *iron bolts* in the center correſpondent to the other floors: *i* the *funnel hole* accordant with *u* in the laſt figure. The dotted lines *k k* trace out the octagon *baſe* of the *lantern*. The place of the *under rail* of the balcony is ſhewn by the dotted lines *m m m*; and *n n n* denote *ſections* of the *ſtuds* upon which thoſe rails are ſupported, correſpondent to the uprights of *Plates* N° 8 and 9.

PLATE, N° 12. *An enlarged* HORIZONTAL *and* VERTICAL SECTION *of the EDYSTONE LANTERN; more particularly deſcribing the* general Frame; *the* Windows *and* Apparatus *for moving and managing the* Chandeliers.

Fig. 1. is the horizontal, and *Fig.* 2. the upright *ſection* of the *Lantern*; the ſcale being three times larger than of *Plates* N° 8 and 9.

The eight corner *pillars* are of *caſt iron*, and, by large *claws* at top and bottom, are ſcrewed upon flat wrought iron bars, of one inch in thickneſs, and four inches in breadth; by which the whole frame is connected together, in a manner that will be more diſtinctly ſhown in *Plate* N° 15. what is peculiarly ſhown in this Plate is as follows:

The ſame letters denoting the ſame parts in each figure above mentioned: *a b* ſhews the *iron ring* of the *great chandelier*, 6 feet 4 inches diameter, and containing 16 candles: *c d* in the *ſmaller chandelier*, and contains 8 candles; diameter 3 feet 4 inches; their reſpective ſizes being ſuch as to diſtribute the candles as near as may be equally over the area of the lantern; ſo as to affect one another as little as poſſible by their heat. Theſe *two rings*, though of different ſizes, are of the *ſame weight*, and therefore a *counterpoiſe* to each other. The circumference of the great ring *a b*, is divided into four equal parts at the points *e f g h*; where four ſtaples or *eyes* are fixed, by which the ring being ſuſpended *horizontally* by cords, each quarter will be equally ſupported: and if two of theſe cords, as *e f* and *g h* are brought together, and reſpectively united into one, at a convenient height above the plain of the *ring*, ſo as to form an inverted A, then each *half* of the ring will become ſuſpended by a ſingle cord, in an horizontal poſition. In the *upright* let the points *i* and *l* be the two points of ſuſpenſion, after the union of the lines reſpectively; the cord *i k* being one of the ſuſpending lines, and *l m* the other. Now each of theſe cords paſſing reſpectively over the *pulley* AB, CD, and then turning downwards cloſe to each other, terminate each in an *eye* at *n o*; and there, each hooking hold of one and the ſame ſmall ring; and this ring having a ſufficient weight attached to it, will ſuſtain and balance the great chandelier, in an horizontal poſition.

The leſſer chandelier is alſo divided into four, and furniſhed with ſtaples, according to the letters *p r i q*, from whence proceed cords, as *p o*, *q n*, *r b*, *i a*, which all unite in the ſmall ring at *n o*; the leſſer ring being, as ſaid, as heavy as the larger, ſerves it for the *counterpoiſe required*.—— Again, if from the points of the *large ring e f g h*, on the under ſide, four cords are appendant, and are united, two and two, as above, ſo as each to form an erect Y, whoſe points of union are at *x z*; then the cords *x 2*, *z 3*, will be perpendicularly under the cords *i k*, *l m*, reſpectively. Alſo if from two oppoſite points underſide of the *leſſer ring*, two cords are affixed, as *t u*, *s v*, united at *v*, and thence depending; then if the cord *n o* is pulled, it is evident that it hauls down the *leſſer* chandelier, and raiſes the *greater*; and if *either* of the cords *x 2* or *z 3* is pulled, it will haul down the larger chandelier, and raiſe the leſſer: and it will do ſo ſo as to keep its *horizontal poſition* nearly: for, if a force is applied to bring down the cord *i k*, its effect will be to raiſe the leſſer chandelier; which giving leave to the hook at *n o* to riſe, in effect gives leave to the rope *n i* to deſcend; and conſequently the whole circumference of the great chandelier falls or riſes together.

The upper works of the lantern having no affixture to the ſtone work but its own weight, I judged it proper to tie that, as well as the whole of the ſtone baſement down to the *cap* of the building. E, F, G, H, ſhew bars in the angles of the lantern, whoſe *dog-heads* lay hold of the baſe of the iron work, and paſſing down the angles, form a *ſtirrup* as at K K; which is confined down by a ſcrew bolt paſſing through the arch. L L L L denote air-holes of about 2 inches in diameter, which can be opened or ſtopped occaſionally, by a *wind of ſaken*.—— The *copper funnel*, fully ſhewn in *Plate* N°9. is here ſuppoſed not put up, except that part which paſſes through, and connects with the *ball*; the conſtruction whereof, ſo as to make a double ſet of *vents*, for the kitchen and for the lantern, without interference, will be beſt conceived by adverting to the *detached Fig.* 3. which is an horizontal ſection of the ball, and tubes, through the middle. The central tube (to which the funnel applies) being ſubſtained by *ſix partitions*, between that tube, and the neck of the *cupola*——The *ſtrengthening bars* of the cupola, the *cramps*, the *angle pieces*, the *lantern door* into the balcony, and the *ſpout*, will appear ſufficiently plain by inſpection.

It is however to be noted, that the *croſs bars* of the ſaſh frames being an *afterthought*, they are here repreſented, rather as afterwards I would have wiſhed them, than as they really were, and which will be hereafter given. This figure ſuppoſes them caſt in one piece with the ſaſh frame; but yet ſo as not to interfere with the glaſs panes. The *detached Fig.* 4. is a ſection of a *window bar*, of its real ſize: the *croſs bars* are ſuppoſed to go no farther than the line *a b*; *a b* being on the inſide, and *a d b* on the glaſs ſide.—I ſhall take this opportunity of remarking, that it would be unneceſſary to continue theſe croſs, or *diagonal* bars, over the *middle pane* of each ſaſh, as the *ſtrength* would be preſerved without it; and the *light* through each middle tier of panes *uninterrupted* for the exhibition of the lights.——*p p* Shew *braſs pins*, two in each ſide of each pane, to keep the glaſs ſteady, independant of the *putty* neceſſary to render the panes *water-tight*.

PLATE, N° 13. *Original* IDEAS, HINTS, *and* SKETCHES, *from whence the general* Form *of the* PRESENT BUILDING *was taken.*

Fig. 1. ſhews the *Rule* of a *ſpreading Oak*; its ſide branches being lopped off, riſing out of the ground with a ſweep; its *taper* diminiſhing till the ſides become perpendicular; and on the inſertion of the great *boughs*, again ſwells, and overhangs. See § * 65. p. 42.

Fig. 2. the manner in which the ſmaller *boughs* and *branches* are obliquely inſerted into the greater, with the *recoiling* curves that form the union. § *ibid.*

Fig. 3. A ſpecimen of *Paving* to be found in the *walking paths of London ſtreets*; being a mode of *dove-tailing* in *ſtone*. See § * 66. p. 43.

Fig. 4. A ſample of *ſtone dove-tailing* in the *upright*, taken from *Belidor's Archit. Hydraul. Part* II. *Tom.* I. *Plate* 20. *Fig.* 4. See § *ibid.*

Fig. 5. A copy of the *firſt* complete *Deſign* made out for the *ſolid courſes* of the Edyſtone. The only material alteration afterwards was to diminiſh the ſize and weight of the outward circle of ſtones. § *ibid.* and alſo 77 and 82.

Fig. 6. Is a reduced copy to half the original ſize, of the *firſt* fair *deſign* for a *Stone Building*, as exhibited to the proprietors § * 68. p. 44. The principal difference afterwards, aroſe from finding leſs area upon the rock; and the neceſſity of *ſize* and *convenience* in the *habitable rooms*.

PLATE, N° 14. *A* VIEW *of the* ROCK *on the* EAST SIDE; *and of the Work advanced to Courſe* XV. *the firſt of the* ENTRY COURSES; *ſhewing the Manner of* landing *and* hoiſting *the* STONES, *&c. in every after Stage of the* BUILDING.

Fig. 1. ſhews the *Boat Weſton* in the *Cut*, delivering her cargo; PQ ſhew the two *fender Piles*, to prevent her rubbing againſt the rock. C The *landing-place*. X The *Cove*, here ſeen in front. D The *Gully*, through which a momentary caſcade makes its way; and which was propoſed to be ſtopped, § 84.

E F G The *Shears*, from the head of which are ſuſpended the *main tackle blocks* A B, whoſe tackle fall, after going to the *ſnatch block* E, paſſes to the *windlaſs* or *jack roll*, whoſe frame being of iron, is faſtened to the rock, as per *figure*.—— The enlarged *detached figure a*, ſhews the *frame* and *roll* frontwiſe, as ſeen from the ſnatch block: *b* ſhews the ſide view thereof, the roll being ſeen endways; *c* ſhews the manner of coupling the *back ſtay* to the *upright ſtanchions*; and *d* ſhews, by a figure ſtill more enlarged, the upper end of the ſtanchions for receiving the *gudgeons* of the roll.

While the ſtone is hoiſting, the man repreſented at I is heaving-in the tackle fall, of the *runner* and *tackle* H K: for, till the ſtones are cleared of the boat, the ſhears lay out conſiderably, and the *out-hawler guy rope* L M is ſlack. This croſſes the *gut*, and is fixed by a ring bolt to one of the rocks of the *ſouth reef*. By ſuch time therefore as the ſtone is hoiſted by the main tackle to the height of the entry door, the ſhears are got into the perpendicular; and then by eaſing the out-hawler guy tackle L N the ſtone comes into the *entry door*.——The runner and tackle H K is hooked to the *guy chain* O, which croſſes the work, and paſſes down to the *ring* on the weſt ſide of the rock; marked R in *Plate* 7.

In the *detached fig.* 2. the *anchor-like* piece of iron by which the main tackle blocks are hung, is ſhewn to an enlarged ſcale at *e f g h*. This anchor being ſuſpended

pended upon a round bolt at *o*, that passes through the tops of the two shear legs, swings freely between them, and always putting itself in a perpendicular position, and producing *fair bearings* upon them, without any unnatural strain or twist, enables them to support the greatest weight possible.——In like manner the two *arms* of the anchor *g h*, having the two guy tackles hooked to them, the action of those tackles is upon the suspending bolt; and the feet of the shears turning freely upon *eye bolts* fixed in the rock, they are at liberty to conform themselves to the position wanted; so that the strefs upon the legs is always *equicate*.

After the building was raised to the height shewn *Fig.* 1, the work was hoisted through the *mill hole*, till it arrived at the top of the *pitch*, by means of the *triangle* and twelve-fold blocks wherewith the work was fet; and are fhewn as ftanding upon the wall at the *firft vaulted floor*, by the letters *i k l m*, being the 4th *ftage*: but after that was completed (the *mill-hole* being too fmall, and the height too great, without lofing time) a *fmall roll* was eftablifhed, as fhewn at the 3d *ftage* in the *lower ftore-room* at Q; and a pair of *moveable fhears*, the figure whereof is fhewn at the 5th *ftage*, as upon the *mill*, at the *kitchen* floor; which, inftead of guy ropes, had a *back leg*, longer than the reft, whofe bottom or foot being cut with a *notch*, ftepped upon the internal angle of the oppofite wall; and was long enough to fuffer them to *lean over* fufficiently for the ftone at P to clear the wall. The fhears themfelves were prevented falling over by a *Luff tackle**, fhewn upon the back leg, whofe lower block hooked upon a *Lewis*, in that ftone the back leg ftepped upon; by which it was brought tight and fteady. When the ftone was to be *landed*, this tackle being a little ftacked, till the notch could be *difengaged*, and then *fet* upon the back leg would, by going over the wall, fuffer the fhears to come to the perpendicular, or beyond it.——The ftones now become in general lefs weighty, a *common tackle* was employed at the fhear head, which would go down to the entry door, and there met the ftones hoifted by the great fhears: the tackle fall of the moveable fhears, being taken to the *jack roll* Q, the ftones were got to the top of the building, in the fame time they were raifed from the boat to the entry door.——The *detached figure* R is the *plan* of the *moveable fhears*; where the *check*, or *fafety* rope *n*, is fhewn at the foot of the back leg. *See* § 267.

In this manner all the heavy materials were got up; the moveable fhears rifing with the work, till the *cupola* was to be fet upon the *lantern*.——The 6th *ftage* fhews the *apparatus* ufed for this purpofe. *See* § 284. The great fhears being now done with, were taken down and put through the windows of the uppermoft room, and there, being well ftradled, ferved as *Booms*. The *detached figure* S being the *plan* of this ftage, fhews their particular difpofition; wherein *e f* fhew the places or feet of the legs of the fhears ufed for this particular purpofe; alfo marked with the fame letters in the relative *upright*. In this the rope *g r* fhews a fide *ftay* to the leg *e f*; and *s t* is the *ftay* of the leg *g f*, each faftened to *q*, the extremes of the *boom*.——From each end of the *crofs-tree* at the head of the *great poles* proceed the ropes *u x*, *y z*, which joining in one *guy rope* at *a*, proceeds over a pully in the end of the temporary timber at *x*: from thence, with the intermediation of a tackle 1, 2, it proceeds to, and fixes at the extreme end of the boom 3; and as the weight to be hoifted will principally lay on this *guy*, the *ftay* or *ftanding rope* 3, 4 is paffed from thence through the window of the room below, and is there fixed.——It is now plain, that by the tackle 1, 2 the fhears can be let go *over* as far as neceffary, and brought back into the perpendicular; but to counteract this main guy, and keep all fteady, the rope 5, 6, 7, with a fmall tackle upon it, performs the office of an *out-hawfer guy*, fixing to the fame ring in the rocks, as that of the main fhears had before done. This apparatus enabled the *cupola* to be hoifted and fet on whole without a *bruife*.

PLATE, N° 15. EXPLANATORY SKETCHES *of* particular Parts *comprehended in the foregoing* GENERAL DESCRIPTIONS.

Fig. 1. is the *plan* of the iron work, at each angle of the lantern, to its full fize. A B B the line of the infide; and C D D that of the outfide of the *ground-ftl bars*, of wrought iron; and the line D B fhews the *mitre joint* of two contiguous bars. *e d e f g* D fhews the horizontal fection of half of one of the *corner pillars* of *caft iron*, and *h i k l g* fhews the plan of the *claw* caft upon each fide at each end; and the fcrews E F in each claw, ferve to ferew down the pillars upon their refpective bars, and unite them all together; and are the fame at top as bottom.——The *corner pieces m n o p q r s t*, being fcrewed on before the pillars were fixed, ferved to unite the bars together; and the quadrangular fpace, *e r s n* being funk lower on the fide *r s* than the oppofite, fhews that the *dog-head* of the *angle bar* fits upon the *ftep*, without danger of being difplaced.——The dotted lines *a w x* fhew the infide, and *y z* the outfide of an horizontal fection of the *glafs plates*; *w x a* being the rabbat in which they are lodged. *w, b, i, 2, 4, 6, 8*, Shew the fection of the border, that goes round the circumference of each *glafs frame*, and that, by fcrews of *copper*, repreſented at G G, this border is fixed to the ftanched border of caft iron *e f g*, which furrounds the face of the pillars.——3, 4, 6 Shew the inside, and 5, 6 the outfide contour, of the *rail* or *glafs bar*, which join the border as fhewn at *b, w, x, a, 6*. The *detached figure* X, as in N° 12, is a *fection at large* of one of the window bars; the point 4 being fuppofed to be placed on the point 4 in the *main figure*.

Fig. 2. is the *upright* corresponding to the *Plan*, (*Fig.* 1.) wherein A B B is the upper, and C D D the under fide of the *ground-ftl bars*. D B X is the elevation of the corner; and D B X Y Z R S fhews the *upright* of one of the *faces* of the pillar and *claw*, and the correfponding dotted line *y z r s* fhews the extent of the projecting border, whofe fection is marked *e f g* (in *Fig.* 1.) G G fhew two of the *ferew-holes* for the fmall copper bolts, that fix the border of the caft frames to the iron ftanch border of the pillars. E E, F F, the two *ferews* by which each claw is fixed. *w, x, a*, Shews the inside of the copper border, and *w, a, 6*, the extent of the rabbat; the fpace P Q at top and bottom, is an enlargement of the breadth of the border, to make all good to the *claws*; and the iron border is made good *between* the claws by the figure bar marked O, both in this figure, and the *Plan*, (*Fig.* 1.) which is riveted upon the *ground-ftl bars* and perforated horizontally for the copper ferews.

Fig. 3. The *iron fire grate* of the *kitchen*, which perfectly vents the fmoke, and warming the room above, is given to an enlarged fcale. The *detached figure* below it, is the plan of the upper bar; the loweft being ftraight, and the intermediate ones reconciled to them.

Fig. 4. gives a *Section* of the *Socket* for the *Candles*; and

Fig. 5. that of the *Lamps*, both to their full fize.

PLATE, N° 16. *Mr.* JESSOP's DRAUGHT, *by which the* YAWLS *were built for the* EDYSTONE SERVICE.

All that I think it neceffary to remark upon this plate is, that the original drawing from whence this is copied, was fufficient for the direction of the *Boat-builder*; and that thofe *Yawls* anfwered well in a *fhort hollow fea*.

PLATE, N° 17. PLAN *and* DESCRIPTION *of the* WORK-YARD *at* MILL-BAY, *with its* FURNITURE *and* UTENSILS.

Fig. 1. The general *Plan of Mill-Bay*, wherein the dotted line *a b c* fhews the line of *low water* fpring tides. *d e* The *channel* dug from low water to convey veffels to the head of the jetty *f g*, *h i k l*. The area of the *Work-yard*. Since the removal of this work, has been built L the *Long Room*; B the *Baths*; A C the *mafjive Barricades*; and D D new ftreets of *Stone-houfe*.

Fig. 2. *Plan* of the *Work-yard* and *Jetty*. A B C D is the line terminating the head of the Channel. Now any veffel laying againſt the two large piles B C, on which a pair of *fhears* being erected, can be unloaded of her cargo of ftone, and delivered upon a *wheel carriage*; that paffing along the jetty to the *turn-rail* E, the carriage is there turned round till it becomes fair with the *rail-road* E F; and paffing along it, enters the work-yard, whofe boundary is marked by G G G G.——At T is another *turn-rail*, which enables the carriage to go on with its burthen; either in the ftraight line, or to turn there and go along the rail-road in the middle of the yard, and arriving at any deſtined point, fuppofe H, it is there met by a *rail-carriage*; for which, planks being temporarily laid, as at I; the burthen (being tranſferred on ſmall rollers) will be eaſily moved thereon, to the extremity of the yard ſideways; and thus ſtones can be depoſited, as at K K (ſhewn *elevation* upward) upon any point of the area of the yard, and returned by the ſame means. § 151. *Note* *, p. 94.

The area boundered by the line G G, and the dotted line I L, is the *Portland Workſhed*. M denotes one of the *bankers*; to which, from the wheel carriage (ſuppoſed on the rail-road oppoſite) *ſtrong laths* being laid, as ſhewn by the dotted lines, the pieces of ſtone are brought on *ſmall rolls*; the bankers having *notches* ſunk therein, to receive the ends of the joints.——In like manner, the area N O was the ſhed for the *Mortſtone Workers*.

The ſquare area P Q, denotes the extent of a *roof* ſupported by four poſts covering the *Platform*; whereof *a b* repreſents the *platings* of rough ſtone walls; *c d* one of its principal *four timbers*, 6 by 12; theſe being covered with three-inch *plank*, and brought to a *true level*, made a *ſtrong floor*, upon which the *courſes* were *brought together*, § 151.——R the *cabin* for the *foremen* of the yard. S a ſmall *ſtore-room* for tools and iron work. G W the *ſtore-ſhed* for *Watchet lime* and *Puzzolana*. V X the ſhed for *hauling* or beating the larger parts of the *Puzzolana* upon W Y, the *bank* with three caſt *iron beds* upon it.

Fig. 3. Suppoſed a *detached figure*, being the *ground plan* of the *turn-rail* at T, (*fig.* 2.) to an *enlarged ſcale*, wherein A B is a *dormant circle* of wood, well ſupported; of which C marks the *center pin* fixed in the tranſverſe beam D D: E E being connecting ſtuds. F F are portions of the *rails*, whereon the *wheele* moves, which are kept in place by the *fillets f, f*, nailed on each ſide. G G ſhew the *ſtoppers* for ſupporting the rails at about a yard's diſtance middle and middle; as is alſo ſhewn near E in *Fig.* 2.

Fig. 4. is the *Plan* of the moveable *turn-rail*, and *Fig.* 5. the relative *upright*; ſhewing alſo the ſection of the dormant circle. The three laſt figures having a mutual reference, the ſame parts are marked with the ſame letters: and further-more, in *Fig.* 4 and 5. H, I ſhew the *rail part* of the turn-rail, correſpondent to thoſe parts marked F F, *Fig.* 3. in *width* and *height*. The *rail parts* H, I are ſtrongly framed upon the *croſs beams* K K, and connected by the pieces L, L. The whole being pointed, with its burthen, upon the pin C, but without abſolutely touching the dormant circle A B while turning; for bearing only upon the *flat ſhoulder* of the pin, it turns eaſily; but, when it is *bringing on* or *wheeling off*, the *equilibrium* upon the pin being deſtroyed, the ends H, I are then ſupported upon the dormant circle, and the wheels will move ſteady.

Fig. 7. ſhews the *Plan*, and *Fig.* 8. the *upright* view of the *wheel carriage* to the ſame ſcale as that of *Fig.* 3, 4 and 5.——Alſo *Fig.* 9. and *Fig.* 10. give the upright views of the *Roll carriage* in two directions to the ſame ſcale; which ſhew diſtinctly the manner of ſupporting the *axis* of the rolls on *iron frames*; and how the iron frames are kept upright by four pair of *croſs bars*.

Fig. 11. gives the upright of the *Capſtand roll*, *axis*, and middle part of the *bar* to the ſame ſcale.——At 1, 2 is ſhewn the capſtand in full, to the *ſcale of the yard*; and 3, 4, 5 mark the *direction* of the rope; which, from a *ſnatch-block* at 5, aſcends to the upper block of the *main tackle*, ſuſpended from the top of the *ſhears*; at per *Fig.* 6. wherein the *in-hauler* guy-tackle is marked 7, being a *runner* and *tackle*; and the *out-hauler* marked 8, are *ſimple blocks*.——The guy-rope 7, 6 was attached to a *ring-bolt*, paſſing through a large rough ſtone, rammed into the ground; its place being ſhewn at 6, (*Fig.* 2.) the out-hauler guy 8, 9 being ſecured in the ſame manner.——The marble rocks marked 10, go round the point of the Bay.

Fig. 12. is the *elevation* of the upper part of the *jetty-head* in front, with the *ſhears* upon it, to an *enlarged ſcale*; more particularly to ſhew the ſmaller parts. A, B, the front pair of piles to which the *croſs beam* C D is bolted; and in like manner to each pair of piles. E, E the ends of the longitudinal *half baiks*; F F the *croſs joiſts*; G, G the ends of the flat *rails* that the wheels of the carriage run upon; H H being a ſingle *croſs timber* ſerving as a *ſtop* to the carriage at the end. I, the ſnatch-block.——N. B. The *ſcantlings* are marked, becauſe, this jetty or ſcaffold, erected *as ſlight as poſſible* for a temporary purpoſe, ſuſtained the whole tonnage of the Edyſtone matter, in and out, without derangement.——The *detached Fig.* 13. gives a part of the top of one of the *ſhear legs*, ſhewing how they were *plated* on each ſide, to ſupport the *hair* of the anchor from bending, and

* A *Luff Tackle* commonly conſiſts of a pair of double blocks, being of the lighter kind for promiſcuous uſes.

and thereby from splitting the poles.——*Fig.* 14. is the enlarged figure of the *runner* and *tackle* (marked 7. in *Fig.* 6.) K, the *runner-block*, of one large fingle pulley; L M, the *tackle-blocks* of three pulleys each, making a purchafe of twelve *equivalent* to the great blocks. *(See the Poſtſcript.)*

Fig. 15. gives an upright *diagonal view* of the *main tackle blocks*; having fix pulleys each upon two pins; the larger *tier* being two, and the leſſer eight inches diameter. This figure diſtinctly ſhews the method of *ſalvagee ſtropping*; being *double*, that the pins being readily knocked *out*, they could be frequently *greaſed* without trouble.——N. B. The *ſheaves*, *blocks*, and *tackles* uſed at *Mold Bay* were nearly the ſame as at the Rock; and *one pair* of main tackle blocks at each place, with the *ſame pulleys*, went through the whole ſervice; but the pins were renewed each ſeaſon, and ſometimes oftener, being of *wood* on account of the *ſalt water*; but were frequently greaſed. The *main tackle-fall* at each place was no larger a rope than of three inches circumference; being a *white rope*, remarkable *ſoft* laid, *hawſer-faſhion**; and which is of material conſequence.

PLATE, N° 18. Deſcriptions *of* SUPPLEMENTAL MATTERS, *having* Reference *to the EDYSTONE* BUILDING.

Fig. 1. contains an upright *front* view of the *great tackle*, or *purchaſe-blocks* of twenty *ſheaves* or pullies, mentioned § 106, 127.

Fig. 2. A *ſide view* of the ſame blocks, referring to *Fig.* 1ſt. The *advantage* of this conſtruction is, that the tackle-*fall* or *running*-rope may be *reeved* through the twenty ſheaves, without a *croſs* or interference; ſo that the ſtanding part, or beginning, may be in the *middle* of the upper block; and the *ending*, hauling part, or *fall*, upon the *middle pulley* of the ſame block. The weight therefore being ſuſpended by twenty ropes inſtead of ſix, as in common *triple* blocks, the *tackle-fall*, as relative to a *given* weight, may be *leſſer* or of fewer *yarns* in the ſame proportion; which renders the whole much more *flexible* and *pliant*, and which, together with the advantage derived from the *mode* of *reeving*, occaſions their *riſing* and *falling* nearly upon a *parallel*.——The *uſes* and *advantages* of theſe blocks, and alſo the *method* of *reeving*, are ſo particularly deſcribed in the *Philoſophical Tranſactions*, *Vol.* 47, for the years 1752 and 1753, and are now ſo well known, that I ſhall but juſt touch upon the *principle* wherein the *reeving* is performed. Beginning in the middle, the *greater* ſheaves are reeved as far as can be on them; from thence going to the firſt of the *ſmaller* ſheaves, and reeving the *whole* of them throughout, you then go to the *firſt* of the *greater* ſheaves, before left *unreeved*, ending upon the *middle ſheave* of the upper block; and thus ariſes a *diminution* of the *friction* from the more *equal diſtribution* thereof.

Fig. 3. being an *upright ſection* of the *ſtore-room* to an *enlarged ſcale*; in it is ſhewn the *center* whereon the *upper ſtore-room floor* was turned; and in like manner the reſt.

Fig. 4. is the *Plan* relative thereto, the *letters* being common to both. *a b, c d* Shew two of the ſixteen *ribs*, formed to the circle of the *vaults* of the floors. Theſe ribs are connected at their ends by two *wooden rings*, *e f g, h i k*; the *former* ſupported by four poſts, three of which are ſhewn in their places; and the *latter* by eight; of which only one is ſhewn on the right hand, and one on the left, to avoid confuſion. The *rings* are each made to take aſunder, that after ſtriking the center they might be got out of the room.——At *l, m n*, two of the ribs are ſuppoſed taken out, to ſhew their bearings upon the rings; they were *open centers*, that it might be ſeen underneath when the joiſts were fair. *Fig.* 7. of *Plate* 11. ſhews how the 16 radii of ſtones would apply to the 16 *ribs*. In *this Plan*, *Fig.* 4. A ſhews the *wall hole*, and B B the croſs timbers for ſupporting the four middle poſts, whoſe places are marked out by dotted little ſquares.

Fig. 5. is an *elevation*, and *Fig.* 6. the *relative plan* of a *Dial Stone*, taken profeſſedly from the general figure of the Edyſtone Lighthouſe; being the deſign of the late *James Duke* of QUEENSBERRY; and by him erected at *Ameſbury*, *Wilts*, with a Dial upon it, by MR. RAMSDEN.——The drawing, of which this is a copy, was given me by the *Duke*; and is placed here as an inſtance, that the *Edyſtone column* may be applied to ſome uſes of *Architecture*.

Fig. 7. repreſents one of the *ſilver medals*, given to the *ſeamen* as a *token* of the ſervice, § 161.

Fig. 8. ſhews the *tool* wherewith the ſtones were got up from the *bottom* of the *gut*, mentioned § 212. A, one of the ſtones with two *trenail holes*, as per § 163.

Suppoſe this ſtone lying flat in the bottom of the gut, the ſide A uppermoſt. The tool has a *pole* or *ſtaff b b* about twelve feet long, ſufficient to reach to the bottom. The ſingle *prong c* is forged to a very gentle *taper*, ſuch as to be thruſt eight or nine inches into a *trenail hole* (all of them being bored to a gauge) it can be driven by the pole, till *foſt*; obſerving that the arm *c* correſponds to the *center of gravity* of the ſtone. The water is generally ſo clear as to ſee the bottom; and in caſe of any *ruffle* by the wind, can be in a great meaſure freed from agitation, by looking through a *ſpeaking trumpet*, whoſe mouth is put down eight or ten inches into the water. The rope *d e f* being then *ſet upon* by the *main tackle*; inſtead of its drawing *out*, the length of the arm *g* cauſes the *prong* to *jamb* the taper in the hole; and the ſtaff being quitted by the hand, with a cord to hinder its flying off too far, the whole aſſumes the poſition of the *figure*; and when brought above water, is lowered into a yawl.

Fig. 9. is a ſection of one of the *mortar buckets*, and in it the *beater*. This figure will need no further explanation, after what is ſaid § 221.

Fig. 10. ſhews one of the *internal* faces of the lantern's *glaſs frames*, to the ſame ſcale as Plate N° 12, and therein the *croſs bars* of *iron* as they were actually fixed according to § 290 and 291.——Beſides the *flat* at each end of each bar, diſtinguiſhed by a *darker ſhade*, and through which the *ſcrews* paſſed; each end was alſo *cranked* about an inch, ſo as to ſet the tranſverſe part of the bars, clear of the copper faſh frame *a* and they were clear of each other at their *interſection*, by one of them being made *ſtraight*, the other *curved* in that part.——This figure, is leſs *regular* than what is ſhewn *Plate* N° 12, yet I do not look upon this aſſemblage as leſs capable of *reſiſtance* to *external violence*, or leſs uſeful in regard to the *tranſmiſſion* of *light*; for all the *panes* being taller than the *candles*, the *chandelier rings* are ſo hung, that when the candles are at *reſt*, diſpenſing their light, that of *one chandelier* paſſes through the *range* of panes A, and that of *the other* through the *range* B; and when the candles are *ſnuffed*, one of the *rings* of lights being ſeen through the range C, the *other* mounts to D, and *vice verſa*.

Fig. 11. ſhews the *Chain* of *triangles*, from the *Edyſtone* to the *Flag-ſtaff* of the *Garriſon* of *Plymouth*, for aſcertaining their *diſtance* trigonometrically.

Fig. 12. is an *enlargement* of the work within the *Headlands* of the *Sound*, the ſame letters marking the ſame points in both: wherein E denotes the *Edyſtone*.——R *Rembard*.——M *Mewſtone*, or *Mewſtone*.——P the *triangular tower* on Point *Penlee*.——S *Staddon* Battery Houſe.——W the *weſtern* temporary *beacon*.——G the *eaſtern*, upon the *Glacis*, near the *weſt baſtion's* turret.——B a *ſtation* at the middle of the baſe.——F the *Guardſhip's flag-ſtaff*.

The whole country about *Plymouth Sound* being very uneven, I could not readily obtain a *baſe* better, than by very carefully meaſuring the *two lines* B G, B W, taking the intercepted angle W B G; whence the right line W G was obtained, making a *baſe* of 1,871 feet, and which I cannot ſuppoſe to err more than half a foot.——Again, the neareſt place from whence the *two beacons* W, G could be *commodiouſly* ſeen for the *purpoſe*, was the point S; and all the *three angles* of the triangle W S G being likewiſe carefully taken, I conclude the angle W S G = 10° 23', taken *true* to a minute; that is to $\frac{1}{360}$th part of the whole angle. The line S W could therefore be determined within $\frac{1}{50}$th part; which being conſidered as a *new baſe of larger extent*, may be eſteemed true within $\frac{1}{300}$th part of the whole.——From this, and the angles *taken* as *marked* upon the ſcheme, the lines W P, W M, and W E, were ſucceſſively determined; and finally P E, the diſtance of the *Flag-ſtaff* from the *Edyſtone*, came out very near, but ſomewhat leſs than, 14 miles.——But the *interior* harbour of *Plymouth*, called *Sutton Pool*, being about 3 furlongs farther from the *Edyſtone* than the *Flag-ſtaff*; the whole diſtance may be eſteemed 14$\frac{1}{2}$ miles from *Plymouth Harbour*.

PLATE, N° 19. A MAP *of the* COASTS *and* COUNTRY *near the SPURN POINT.*

It appears that this Coaſt, from *Flamborough Head*, or at leaſt from *Bridlington* to the *Spurn Point*, trending S. S. E. *(true Merid.)* and the tide of flood of the *German Ocean* ſetting ſtrongly to the ſouthwards; this will cauſe theſe flood-tides, when agitated by all winds from N. N. W. to N. E. to *ſet* very hard upon this *ſtretch* of coaſt; and, no part of it being rocky, to *move away*; the ſand and matter diſlodged to be driven towards the ſouth, forming at the tail of the land, the *appendage*, called the *Spurn Point*, § 321. Doubtleſs this matter ſo brought would in time *ſhut up* the *Humber*, was it not for the *powerful re-ſtop* of that river's tide, aided by the freſh water from the higher country. The *Spurn Point* being therefore the effect of a *ſtruggle* between *the ſea tide of the German Ocean* and the *re-flow* of the *Humber*, we are not to wonder if the powerful effort of the bet by degrees drives the *channel* of the *Humber* ſouthwards towards the *Lincolnſhire coaſt*, thereby giving opportunity for the *Spurn Point* to *lengthen* towards the ſouth, § ibid. and, as the coaſt wears away, as which it *hangs* as a *rudder*, to be alſo in a ſtate of *travel weſtward*, § 320, and 322.

PLATE, N° 20. PLAN *of the SPURN POINT, as in* 1786. *Alſo its* VARIATIONS *during the preceding twenty Years.*

Fig. 1. is the *Plan* of the *Spurn Point*, as taken in the year 1786, comprehending about 98 acres; upon which little needs to be ſaid, after what is upon the *face* of it, and § 323 is conſidered.

Fig. 2. is an enlargement of the *extreme* point of the *Spurn*, wherein the boundary line of the *Sand Hummocks*, and its relative *high water line* is marked with the *year*. The ſpace comprehended between theſe two lines was a kind of flat area or *fore ſhore* over which the ſea beat in *rough weather*, and upon which (the whole being then conſidered as *rapidly increaſing*) the *lower light* was propoſed to be built at A; ANGLE's *Lighthouſe* being at that time in uſe; and within the boundary of the *fore part* of the *peninſula*, § 329. B was the place marked out for the *high light*; and parallel to A B, the propoſed *line of direction*, at the diſtance of 23 *yards* to ſouth-weſtward, were the two points C, D marked out for the *temporary lights*; but for reaſons that appeared before their erection, the point C was in reality carried to E.——F, a low building, containing *two cottages* for the temporary *light-keepers* was erected at the ſame time. When the Lighthouſes were begun in 1771, the high water line was as marked for that year. For *reaſons*, § 320, the *low Light* marked at A was placed at G. The *high Lighthouſe* was begun the latter end of the year 1772, and placed at H, § *ibid.*——In 1773 the high water line was as marked, and the boundary of the *Sand Hummocks* remained nearly the *ſame* for ſome time; but a *great ſtorm* in *January* 1776 varied the high water line, as marked for that year, and deſcribed § 322. After this there was little variation of that line to the *concluſion* of the work in 1777.

On viſiting the *Spurn* in 1786, the *high water line* ran as deſcribed for that year, approaching near to the *Low Light Machine* at Q.——I K L, *Fig.* 1. is the high water line, and M N O that of low water; from which it will appear, that the *Spurn Point* marked P, is advanced conſiderably to ſouth-weſtward from the line of direction, and has conſiderably retreated to north-eaſtward, or nearer *a-breaſt* of the *high Light*.——Of the *ſtand* R there were no traces in 1777; but now, being grown with the *bent graſs* the *ſand hummocks* had eſtabliſhed themſelves, and rendered the ſurface irregular.——It appears that *little change* has happened near the *high Lighthouſe*, but that the *breadth of ſand* was there *increaſed*.

PLATE, N° 21. SECTION *of the* HIGH LIGHTHOUSE, *upon the SPURN POINT, to the ſame Scale as the* Edyſtone.

A A The level of the *Pavement* of the *circular court-yard*.——B The *Coal Vault*.——C is a room for the *Smith's Shop*, and *Machine* for hoiſting the coals.——D is a *vacant* room.——E, the *dwelling room*, having two oppoſite *fire places*, to be uſed as the wind ſuits.——F and G *upper* chambers.——H The *Pipe Room*;

* A rope laid *hawſer* faſhion is a rope conſiſting of any number of yarns according to the ſtrength required, which divided into three *ſtrands*, and each being twiſted equally, are prepared to be *laid* into a rope. But if this, or any ſimilar rope is farther twiſted, equally with two others, ſo as to make three *ſtrands*, their will form a rope, ſaid to be *cable laid*.

wherein I K, are two of eight *air pipes*, that convey air from the external *hopper-mouths*, to I, the *receptacle*; which is lined with thick *plate iron*; the bottom being *stone*.——When the door is shut, the air ascends through the large *funnel* M, and the *hearth* N, to the fire grate. § 333.——The *flame* is seen in *every direction* through the windows of the lantern, and the *smoke* is collected in passing the *decagon* conical *roof*, composed of ten *Elland-edge flue stones*; and lastly, through the *copper funnel* at O. The *coals* in the day-time are drawn up in a *tub* from the coal vault, through the opening P; by means of the *roll*, *wheel*, *pinion*, and *winch* at Q. A *rope*, from thence ascending through all the floors, goes over a large *pulley*, suspended from the roof; and thence downward through the hole in the arch at R, goes down the large *square* wooden *pipe* S T, which terminates at T in an *hopper-mouth* proper for *receiving* in the burthen.

The *ashes* and hot *cinders* passing through the grate, fall into the bottom of the *receptacle* I, and by heating the air therein, promotes a *sufficient draught* in the calmeſt weather; and which can be augmented and regulated, when there is a breeze, as any of the *air pipes* can be cloſed at pleaſure.——Every morning when the receptacle is to be cleared, the aſhes and cinders are thrown into the little *hopper* at V, and are conveyed down the ſquare wood pipe V W, through W X, a pipe formed in the brick work, and from thence into a *Bing-ſtead* in the *court-yard*.

The *corner pillars* of the lantern are of *caſt iron*, framed in a ſimilar manner to what has been deſcribed for the *Eaſtſtone*; allowing for difference in ſize and proportion. The *ſaſh frames* are of *oak*. *y y Air holes* in the lantern, occaſionally cloſed with a ſlider. z z Open holes in the *coal vaults* to admit air and light. N. B. In 1786, this building was not ſenſibly out of upright.

PLATE, N° 22. PLANS *of the different* FLOORS *applicable to the preceding* SECTION.

Fig. 1. the ground plan. The outward circle, cloſe piling. The ſtones in the interſpaces of the bearing piles, were large *Elland-edge paving ſtones*, 12 inches depth, driven hard down, after the piling was done, with an heavy *race* men's *perriwers rammer*; intended, excluſive of the piling, to condenſe and conſolidate the whole body of land under the building, that the whole maſs might *ſettle together*.

Fig. 2. an *horizontal ſection* of the *Coal Vault*. Wherein A is the *circular ſtair*, from the entry door to the ſtone floor of the firſt room.——B a Door into the *coal vaults*; C and D the places of two *hatchways*, or openings through the vault. E. W. N. S. mark the *cardinal points* in all the figures; and alſo the places of the air holes of the vault in this.

Fig. 3. the plan of the *Stone Floor* over the coal vault. Wherein, A the *landing* of the ſtairs.——B An out door, having a *gibbet* for hoiſting the coals to the ſtone floor, for their depoſition after the lower door is blocked up.——C An *hatchway* in the middle for the equal diſtribution of the coals.——D The *hatchway* for the *coal tub*.——E The *roll*, *wheel*, *pinion*, and *winch*.——At E. W. N. are three windows; at S is the *gibbet* marked by dotted lines.——F is the *aſh pipe*.

Fig. 4. ſhews the *framing* of the dwelling room floor. The place of the windows in this, as in all the reſt, conform to the *cardinal points*.——G, G The *fire places*.——H The opening for the *ſtep ladder*.——D The *coal pipe*.——F The *aſh pipe*.——Beſides this, there are four more timber floors, of ſimilar conſtructions; the *girders* laying alternately E. and W. and N. and S.

Fig. 5. an *horizontal ſection* of the *pipe room*, *air pipes*, and *receptacle* I K in one of the air pipes; their *hopper-mouths* being ſhewn at L.——One of the *ſliders* is ſhewn in ſlit at M; as applied at N, which is the ſection of its groove. Each pipe having one, they can be regulated according to the *quarter* and *ſtrength* of the *wind*.——D The *coal pipe*.

Fig. 6. *Plan* of the *Lantern* and *Baking Floor*, ready for the reception of the iron work. The large ſt dotted circle ſhews the circumference of the top of the brick ſhaft of the *main column*. A The *Baking Door*.——B The *Hearth*.——C The *Fire Grate*.——D The *falling doors* cloſing the top of the *coal pipe*; and E the falling doors cloſing the top of the *main-hole*; to which the aſcent is by a ladder from the *pipe room*.

Fig. 7. is the *plan*, and *Fig.* 8. the *ſection* of the *Fire Grate* to an enlarged ſcale.——It is chiefly of *caſt iron*; the bottom made to take out. A, B circular bricks, of *fire clay*.

PLATE, N° 23. ELEVATION *of the* high LIGHTHOUSE, *and of the* SWAPE *for exhibiting the* low Light, *upon* SPURN POINT.

Theſe ſtructures are not ſuppoſed to be viewed upon the *line* of *direction*; in which caſe the *figure* of the *machine* would have fallen directly upon the *Lighthouſe*. The line of view is marked in *Plate* 22. *Fig.* 6. being ſeen upon a *bearing* of N. W. by W. ½ W. in which poſition the two *ſtructures* are ſeen *clear* of each other: and, to bring them into *one plate*, the *ſcale* is only *half* the ſize of the two former.——A perſon ſtanding in the *entry door* of the *Lighthouſe*, will ſee the low light machine, or *ſwape*, through the *door* of the *court-yard* wall; which is a circle of 90 feet diameter.

The *Swape*, including the walls whereon it ſtands, exhibits the light at the height of 56 feet.——The *fire baſket* of iron turning upon an axis, always places itſelf *level*, in every poſition of the *maſt* A B. This loaded with a *weight* at A, counterbalances the *iron work* and *fuel* at top; the whole being ſteadied, and clipped into an iron frame, that turns in *equilibrio* upon the *horizontal axis a b*; ſupported by *pillars* and *braces*, as per *figure*.——When the fire wants renewal, the attendant laying hold of one of the *winches* of the *roll c d*, turns it round, ſo as to wind the rope ſhewn at *e* upon it. This rope, after going obliquely towards the ground, paſſes a pulley in a *ſtud*, fixed therein, at ſome yards diſtance; and thence ariſing obliquely upward, as *f g*, it lays hold of the *maſt* by a ſmall chain. By the motion of the *roll* the *fire baſket* is brought to the ground, where it is fed with a ſhovelful or two of coals. While the rope *e* was winding upon the *roll*, the rope *h* being coiled thereon the *contrary way*, was unwinding; and this being attached at A to the extreme of the lower end of the maſt, and at equal diſtance, in riſing it carries the rope along with it. The *fuel* being *renewed*, the *winch* is turned the *contrary way* round; by which, that end of the maſt is brought down, and the *fire baſket* carried up, into the poſition ſhewn in the figure. The lower end of the *maſt* is ſteaded againſt the *croſs piece i k*; the roll being then faſtened.——The projecting part *l* is a ſmall *umbrella* of ſheet iron, ſerving to throw off the falling cinders from the rope.

N. B. The whole operation can be performed in a couple of minutes.

POSTSCRIPT.

IN the preceding references it is mentioned, in the explanation of Plate N° 17, *Fig.* 14. that the compound purchaſe, called the *Runner* and *Tackle*; which conſiſts of one large pulley or ſheave in the runner block; and which together with a pair of tackle blocks, of three pulleys in each; that altogether conſiſt of *ſeven* ſheaves; compoſes a purchaſe *equivalent* to that of the great blocks; which conſiſting of ſix ſheaves each, makes the whole number *twelve*: this laſt, therefore, having a greater number of moving parts, and flexures of the *roving* rope; being conſequently leſs ſimple, and attended with more friction; it will naturally be enquired, by thoſe of my readers who are not *ſeamen*, or verſed in the *mechanic powers*, why the runner and tackle is not to be preferred in *all* caſes?

The *Runner* and *Tackle* doubtleſs, working with leſs *friction*, is to be preferred wherever it can be properly applied; but many are the caſes, in which it cannot be applied: for, it will readily be perceived, by inſpection of Fig. 14. that while the tackle blocks L, M, are hauled together, or brought *Block and block*; and one of them has moved through the ſpace L M; the runner block K will only riſe, or move, through *half* that ſpace, on account of the runner rope being double. It therefore follows, that the weight can be liftied or moved only half the height or ſpace, where a runner is applied, that it could be where the tackle alone is applied. In conſequence, if a weight was to be liftied upon *Shears* by the *Runner and Tackle*, to a *given* height, the ſhears would be obliged to be *twice* as high; which would in moſt caſes be very inconvenient: but where there is height enough; or in the caſe of a *Guy-rope* or guide rope, as in *Fig.* 6. marked 6, 7, there being a conſiderable length of Dead Rope, not engaged with any ſheave; the runner may be of any length, to give the purchaſe the ſcope required.——The *Runner*, therefore, though it doubles the purchaſe of the tackle blocks, it reduces the height to which the weight could be hoiſted by them alone, to *half*.——I ſhall conclude with obſerving, that if the *Great Purchaſe Blocks* of 20 ſheaves (Plate N° 18, Fig. 1. and 2.) were worked with a *Runner*, they would form a purchaſe of *Forty* to *One*; and, of the ſize of Blocks deſcribed, would with ſecurity *hoiſt* a weight of 20 *Tons*.

THE END.

A GENERAL CHART of the SEAS SURROUNDING the EDYSTONE LIGHT-HOUSE

IRELAND
S.t GEORGES CHANNEL
CARDIGAN BAY
WALES
CARDIGAN SHIRE
PEMBROKE SH.
CARMARTHEN SH.
GLAMORGAN SH.
MONMOUTH SH.
GLOCESTER SH.
ENGLAND
BRISTOL CHANNEL
SOMERSET SH.
HAMP SHIRE
DORSET SHIRE
DEVON SHIRE
CORNWALL
MIDDLESEX
ESSEX
KENT
SUSSEX
THE BRITISH CHANNEL
ATLANTIC OCEAN
THE BAY OF BISCAY
NORMANDY
FRANCE
BRETAGNE
POITOU
SAINTONGE

Longitude West from LONDON

Scale of English Miles 69½ to a Degree.

Scale of Nautic Leagues 20 to a Degree.

This Chart comprehends the following Light-houses.

1. Tour de Cordouan
2. Tour de Baleine
3. S.t Agnes. Scilly
4. The Smalls
5. The Lizard
6. The Edystone
7. The Caskets
8. Portland Lights

N.B. Those marked * are double Lights. & the Caskets treble

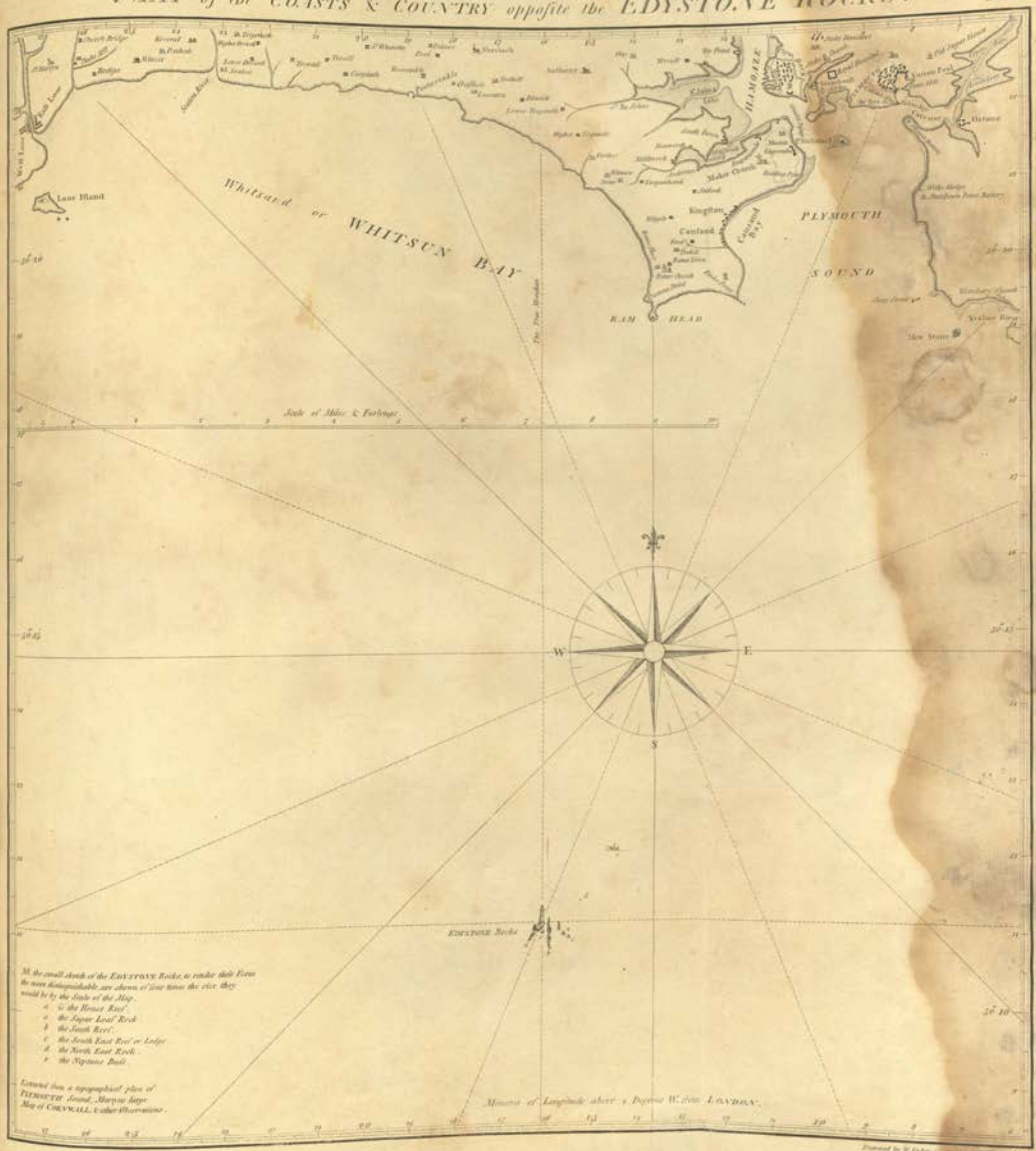
Also a Light house on Cap d Heure & a floating Light on the Coney

N.B. The Numeral Figures denote the depth in Fathoms at Low Water; & the Roman Figures the time of High Water at New & Full Moon.

Engraved by W.m Faden, Geog.r to the King. Extracted from the Channel Chart. 1784

I

MAP of the COASTS & COUNTRY opposite the EDYSTONE ROCKS. N°. 2.

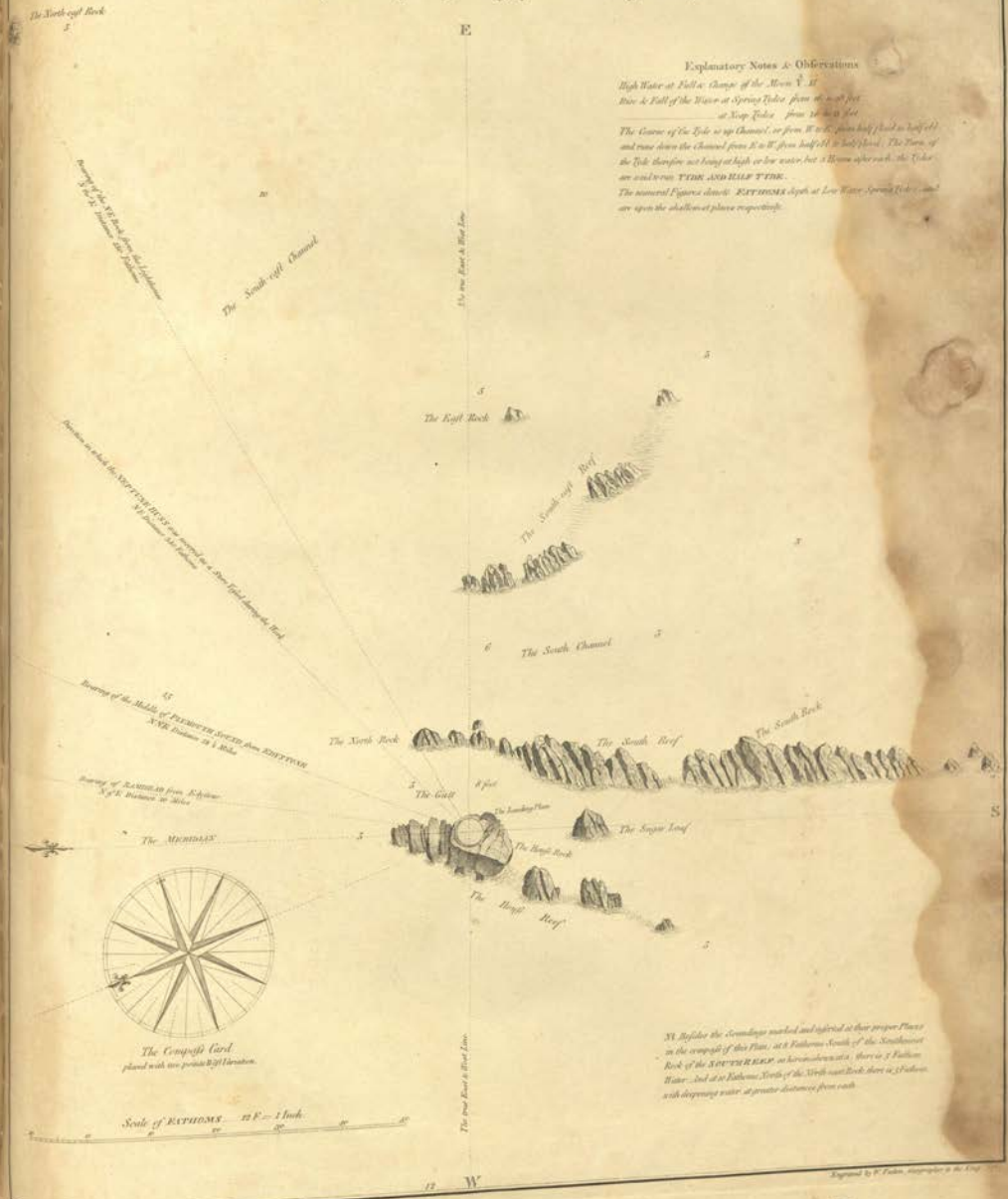


II II

A GENERAL PLAN of the EDYSTONE ROCKS.

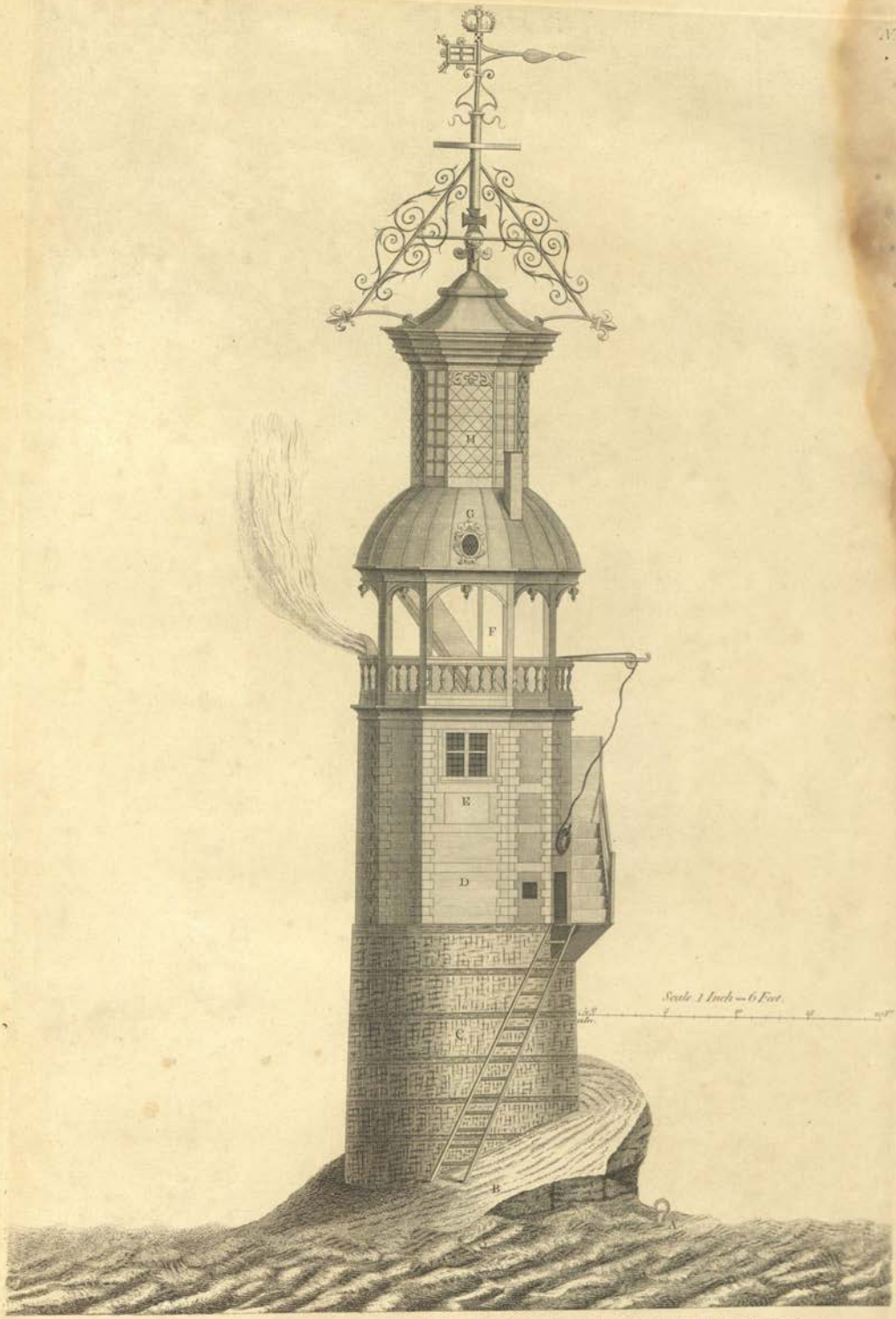
as seen at the low Water of a spring Tyde.

Comprehending every Thing lyable to damage a Ship.


The North-east Rock
E
Explanatory Notes & Observations
High Water at Full & Change of the Moon
Rise & Fall of the Water at Spring Tyde from
at Neap Tydes from
The Course of the Tyde is up Channel, or from W to E. from half Flood to half ebb
and runs down the Channel from E to W from half ebb to half Flood. The Turn of
the Tyde therefore not being at high or low water, but 3 Hours after each, the Tydes
are said to run TYDE AND HALF TYDE.
The numeral Figures denote FATHOMS depth at Low Water Spring Tydes
are upon the shallows at places respectively.
The South-east Channel
The East Rock
The South-east Reef
The South Channel
The North Rock
The South Reef
The South Rock
The Gull
The Smeaton Loaf
The Mewstone
The Hangst Rock
The Hangst Reef
The Compass Card
plained with the prefent Eight Variation.
Scale of FATHOMS. 12 F. = 1 Inch.
W

N.B. Besides the Soundings marked and inserted at their proper Places in the compass of this Plan, at 8 Fathoms South of the Southernmost Rock of the SOUTHREEF, as here underwritten &, there is 5 Fathom Water. And at 10 Fathoms North of the North east Rock there is 5 Fathom with deepening water at greater distances from each

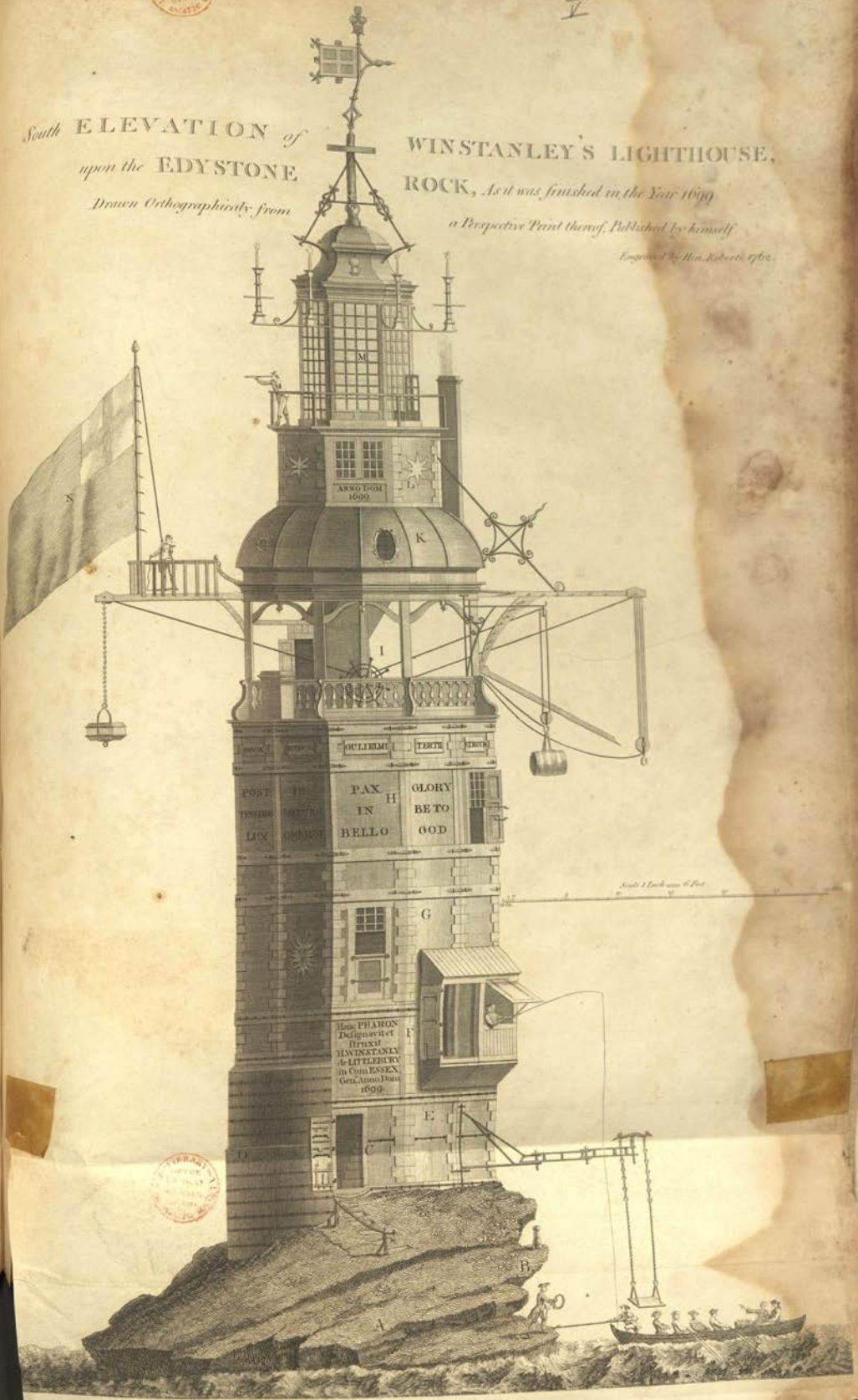
Engraved by W. Faden, Geographer to the King

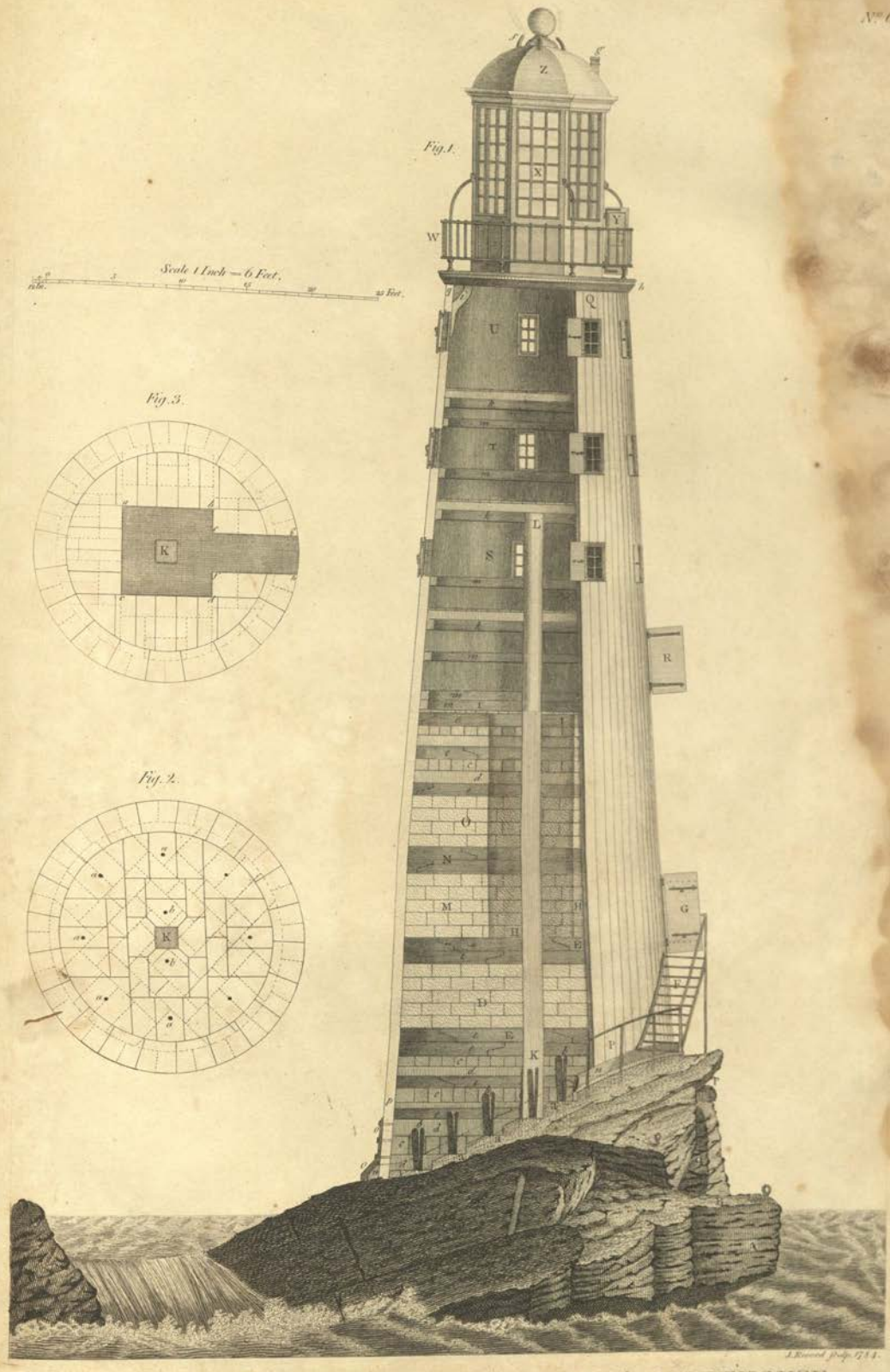


South ELEVATION *of the* ORIGINAL LIGHTHOUSE,
Built upon the EDYSTONE ROCK, *according to the first Design of* Mr WINSTANLEY.
Taken from a Perspective Print, drawn at the Rock, by Jaaziell Johnston, *Painter.* —— *Engraved by* Hen. Roberts 1761.

IV

South ELEVATION of WINSTANLEY'S LIGHTHOUSE,
upon the EDYSTONE ROCK, As it was finished in the Year 1699
Drawn Orthographically from a Perspective Print thereof, Published by himself
Engraved by Hen. Roberts 1760.

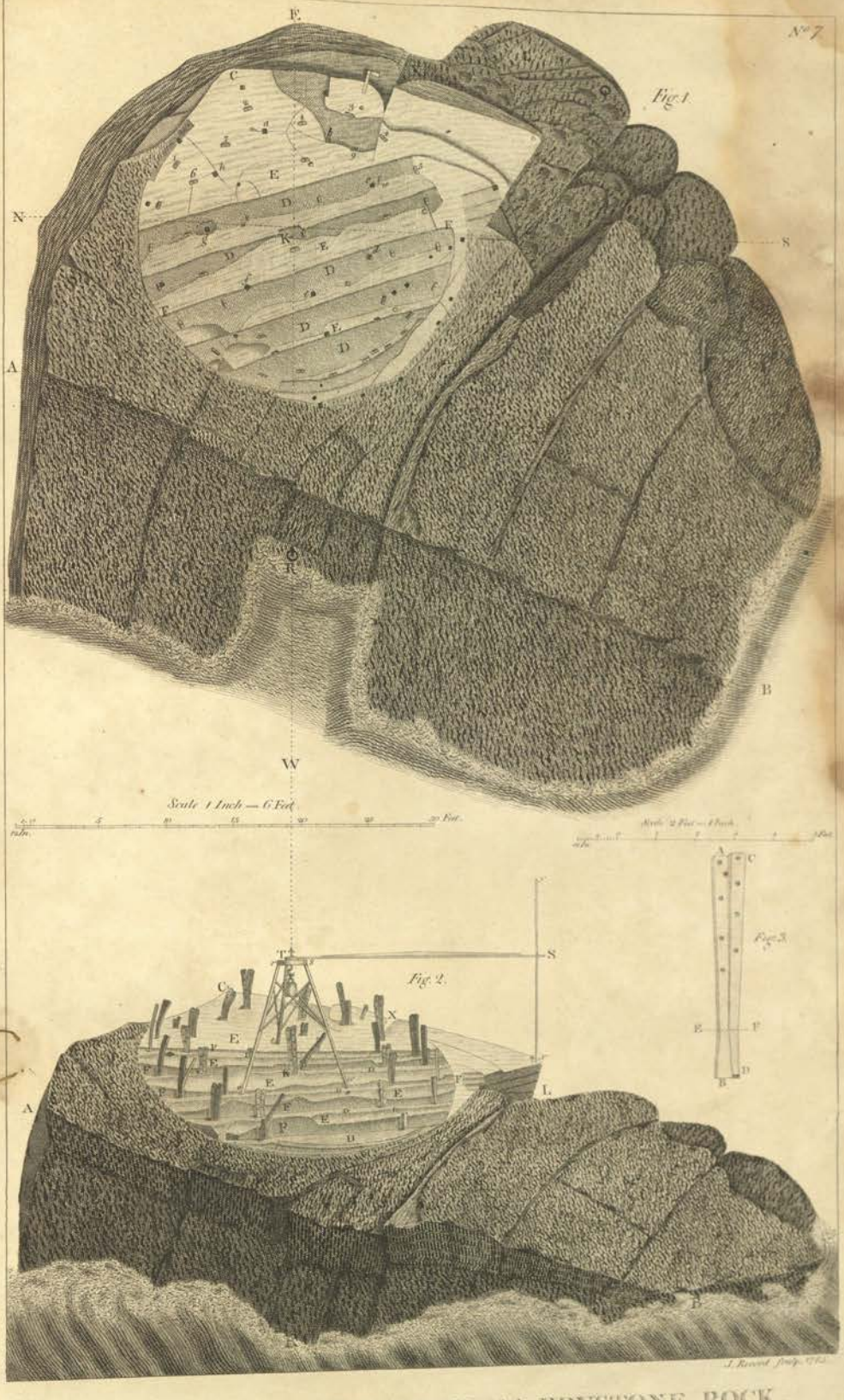




South ELEVATION & SECTION of RUDYERD's LIGHTHOUSE,

Compleated in 1709; represented as it stood previous to its demolition by Fire, in the Year 1755.

VI



PLAN *and perspective* ELEVATION *of the* EDYSTONE ROCK,

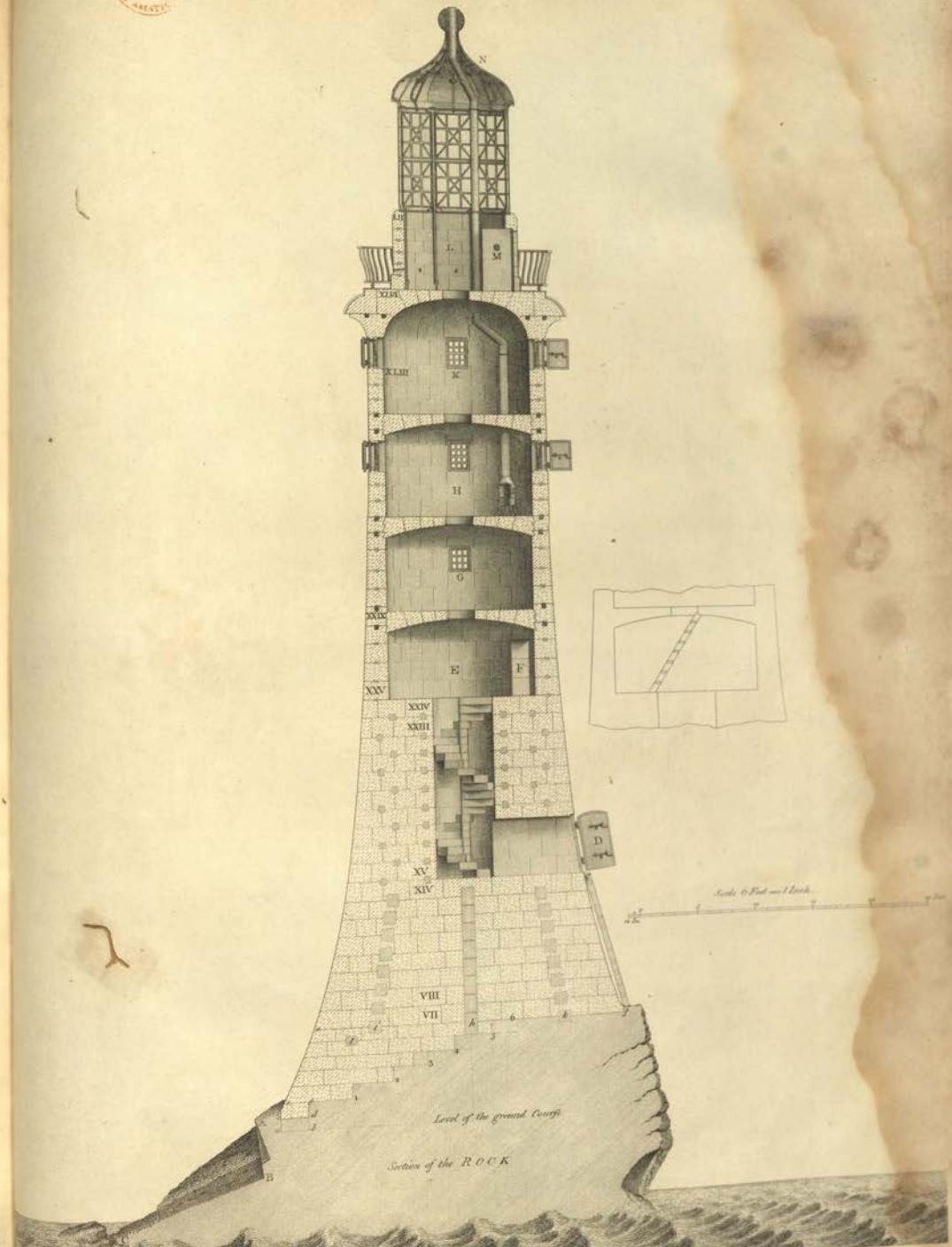
Seen from the West: Taken from the Model thereof mentioned Sect. 105.

South **ELEVATION** *of the* **STONE LIGHTHOUSE** *completed upon the* **EDYSTONE** *in 1759.*

Shewing the Prospect of the nearest Land, as it appears from the Rocks in a clear calm Day.

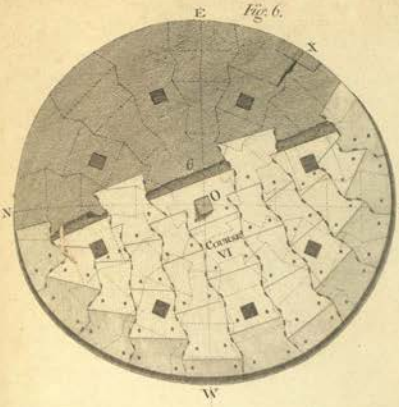
Engraved in the Year 1763, by Mr. Edw.d Rooker; The figures by Mr. Sam. Wale

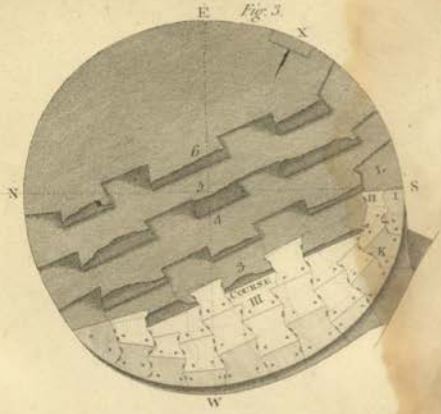
LIBRARY OF THE ROYAL BRANCH OF THE ASIATIC SOCIETY

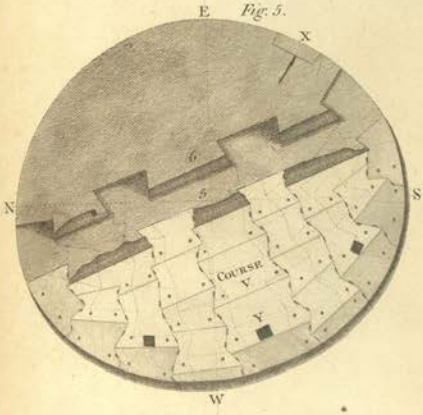


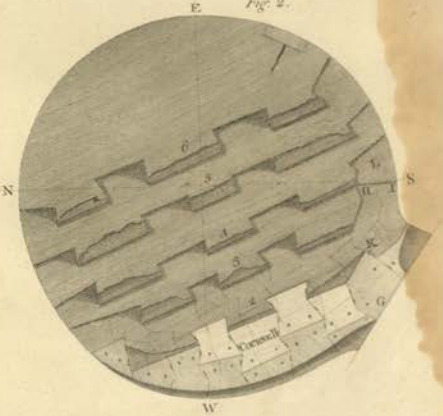
SECTION *of the* EDYSTONE LIGHTHOUSE *upon the* E & W. *Line, as relative to* No. 8.
on Supposition of its being LOW WATER *of a* SPRING TIDE.

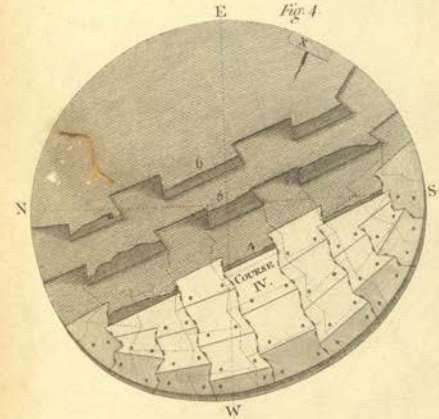
Engraved in the Year 1763 by M. Tibbs Rodner

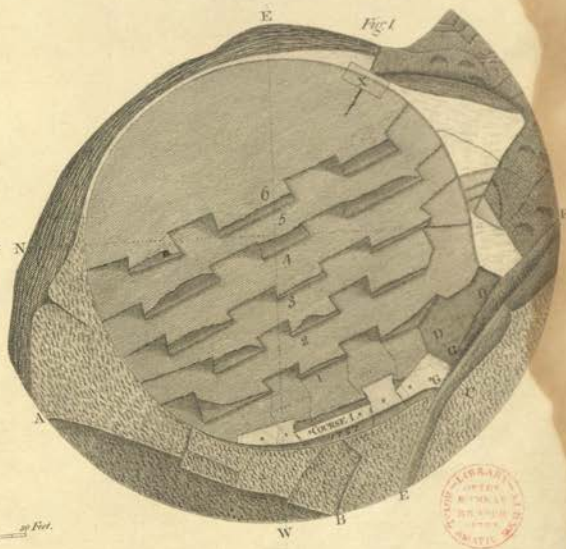








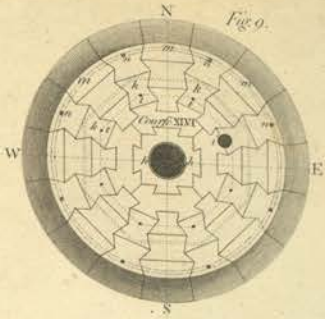


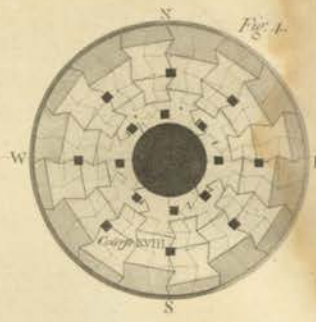


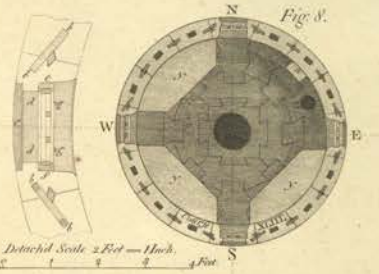
PLANS *of the* ROCK *after being cut; & prepared to receive the* STONE BUILDING.

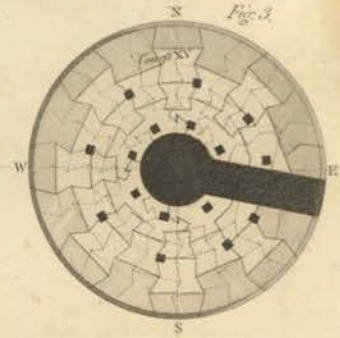
Shewing the Six FOUNDATION COURSES.

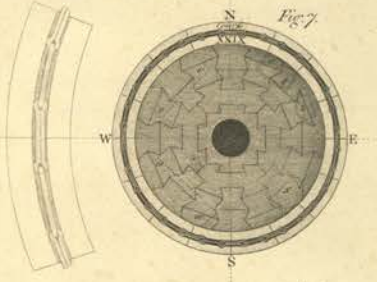
J. Record sculp. 1786.

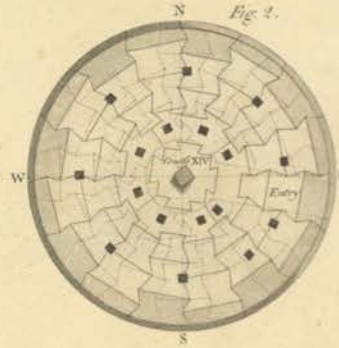


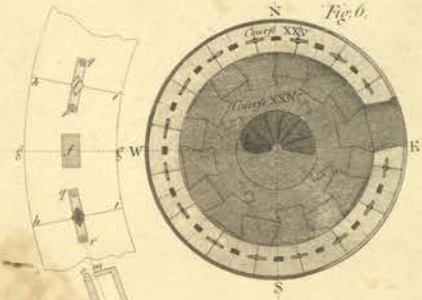


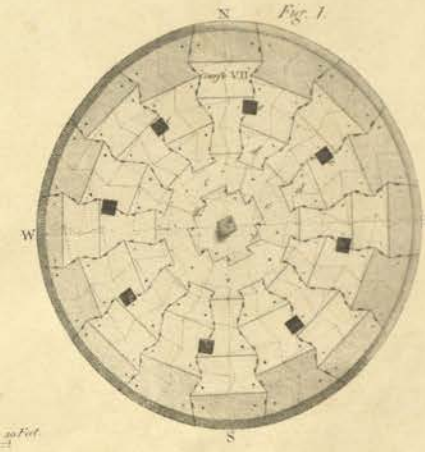


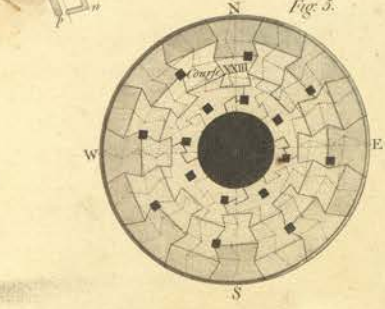






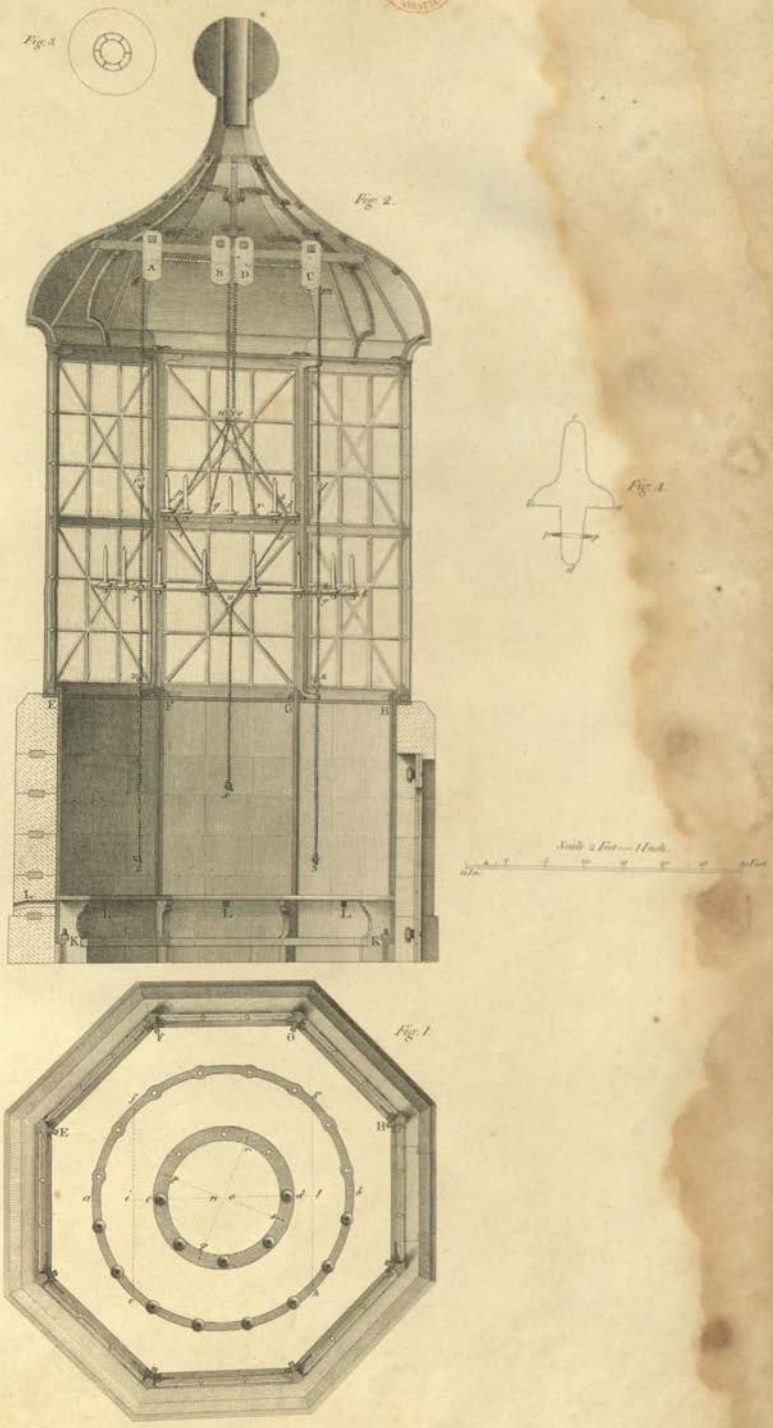






PLANS *of all the Different* COURSES *from the Top of the* ROCK *to the Top of the* BALCONY FLOOR *inclusive.*

J. Record Sculp. 1786.



An enlarged HORIZONTAL & VERTICAL SECTION *of the* EDYSTONE LANTERN; *with the* CHANDELIERS.

Engraved in the Year 1763 by Mr. Edw.d Rooker.

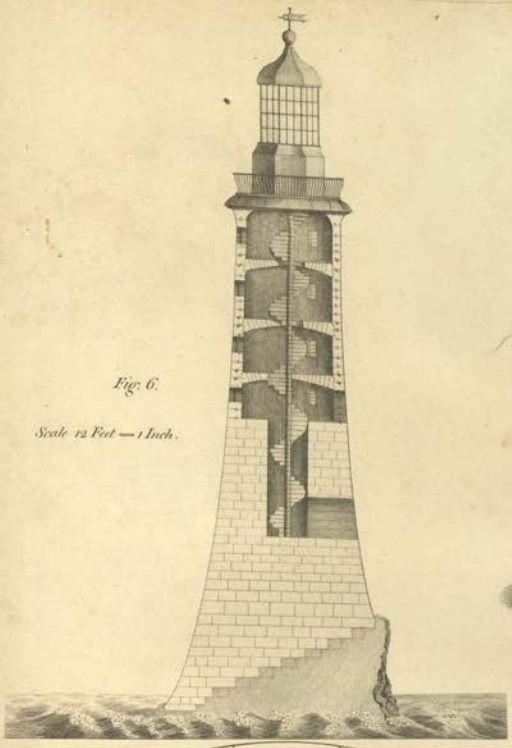


Fig. 6.

Scale 12 Feet — 1 Inch.

Fig. 2.

Fig. 1.

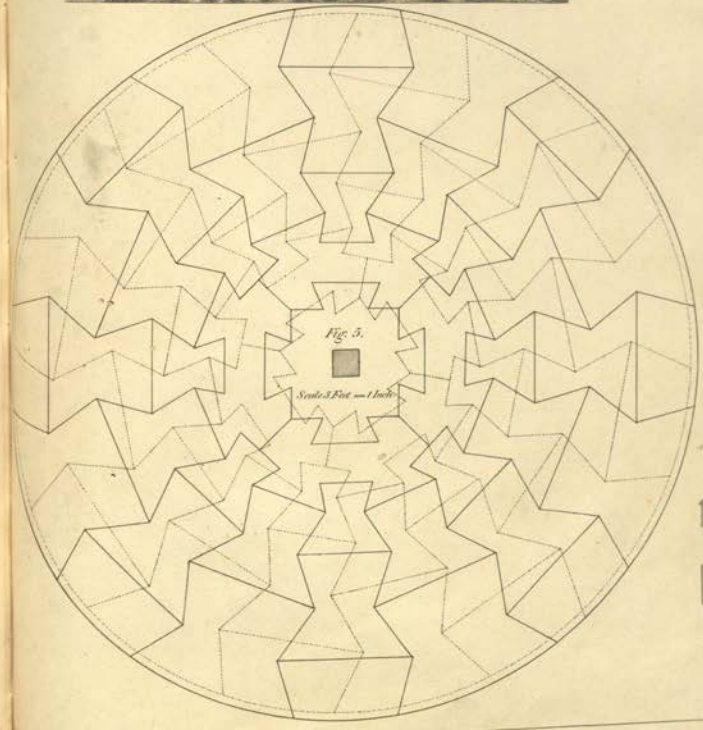


Fig. 5.

Scale 3 Feet — 1 Inch.

Fig. 4.

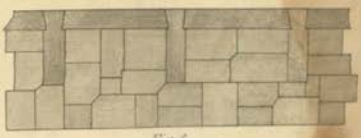
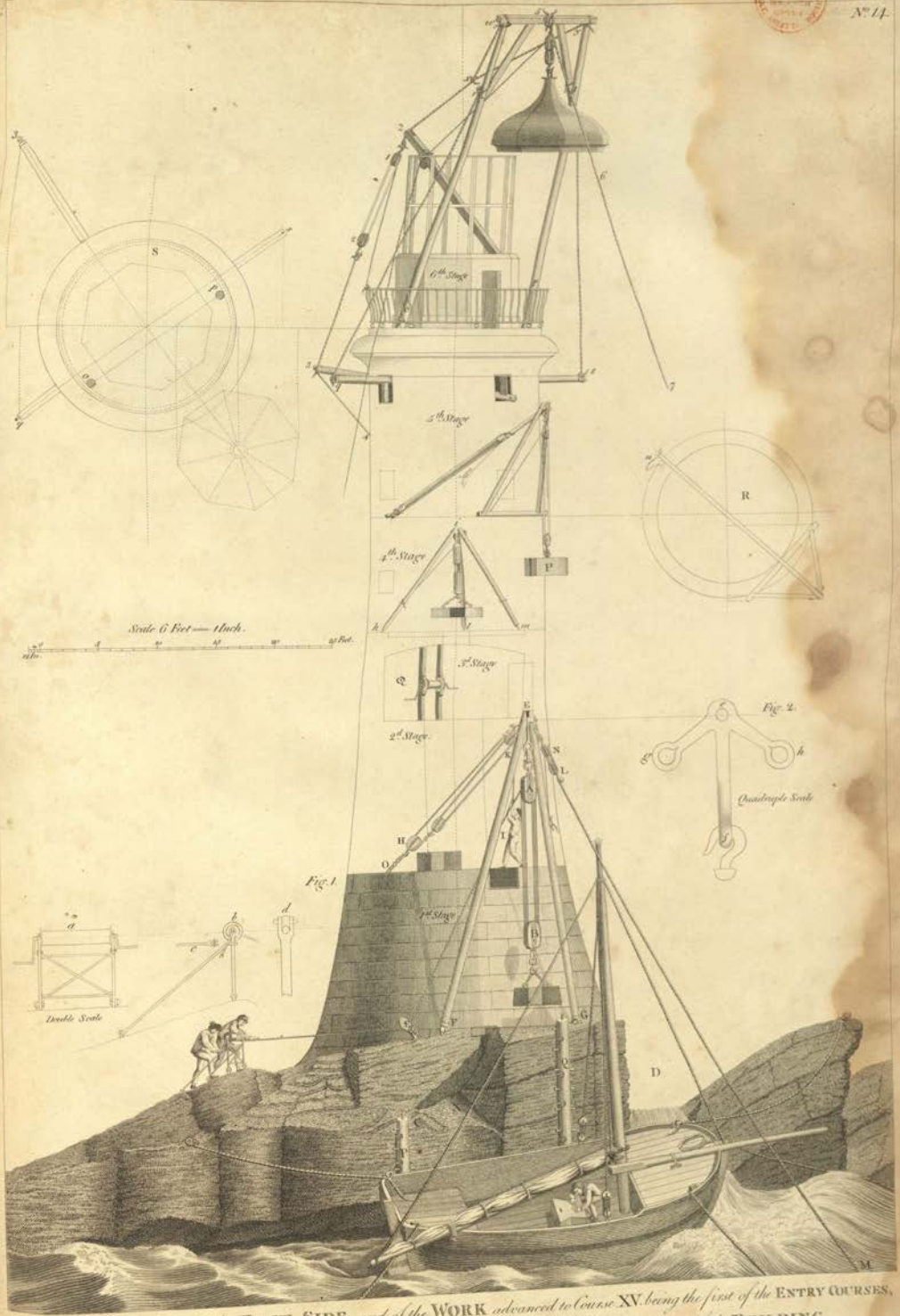


Fig. 3.

Original IDEAS, HINTS, & SKETCHES, *from whence the* FORM *of the* PRESENT BUILDING *was taken.*

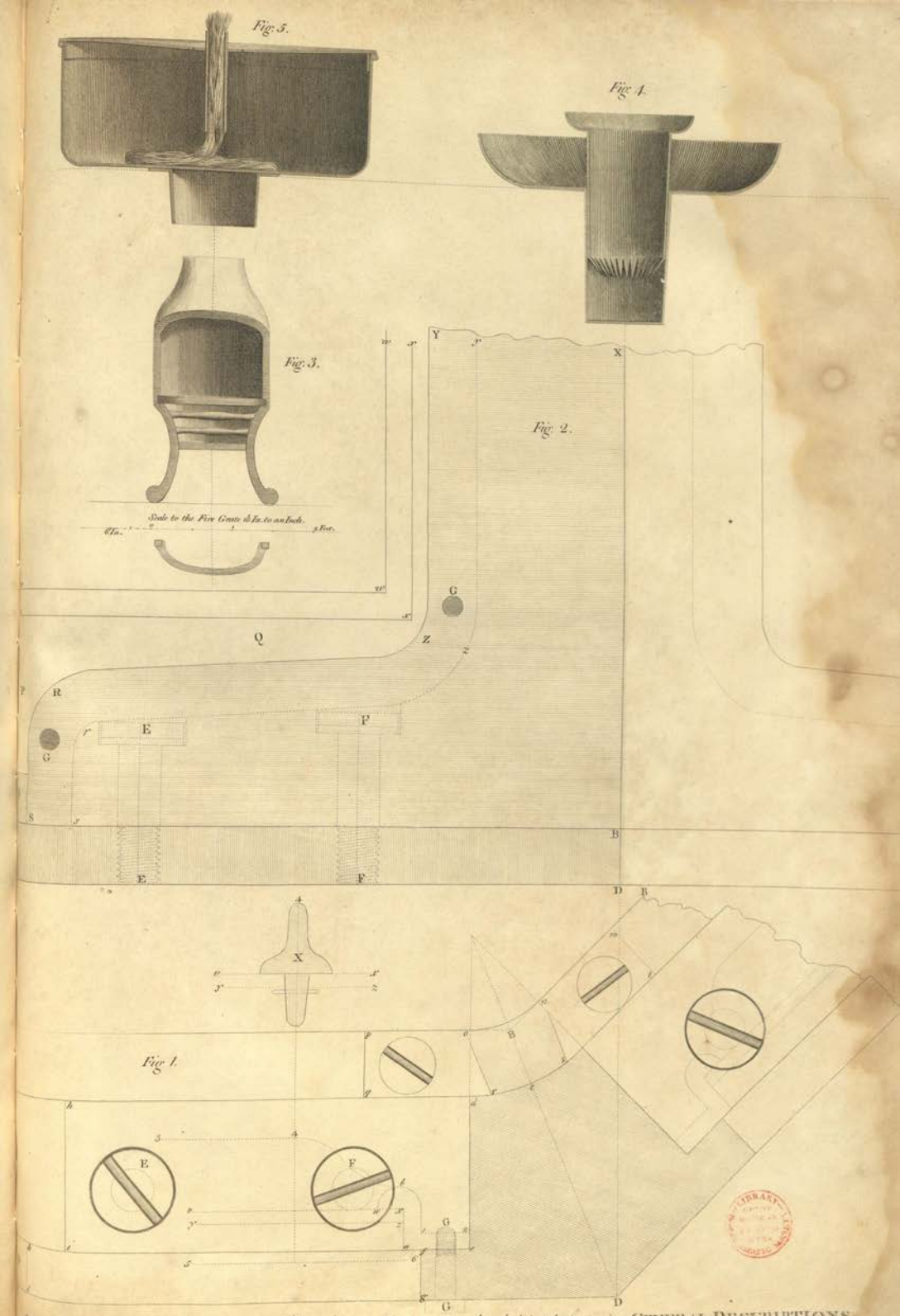
J. Record sculp. 1786



A View of the ROCK on the EAST SIDE, and of the WORK advanced to Course XV. being the first of the ENTRY COURSES,
Shewing the manner of LANDING and HOISTING the STONES &c. in every Stage of the BUILDING.

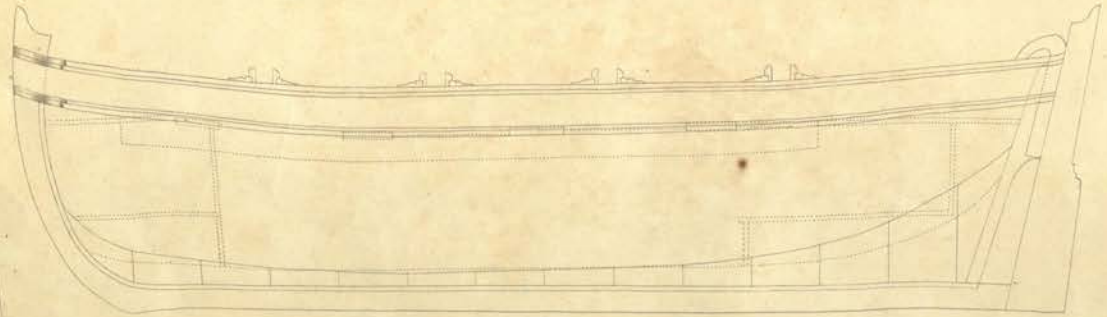
J. Record Sculp. 1786.

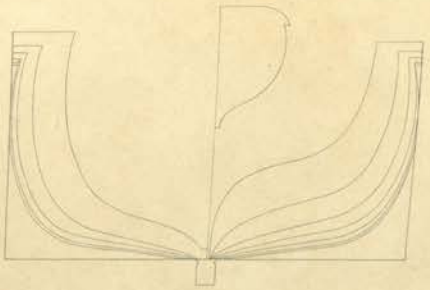
The Figures by M.r C. R. Ryley.

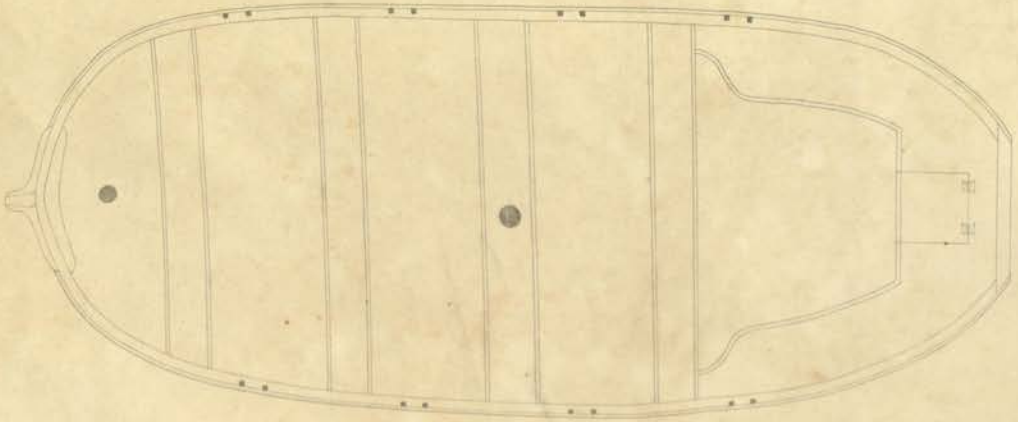


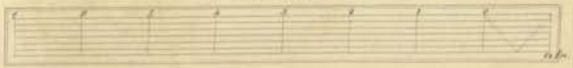
EXPLANATORY SKETCHES *of Particular Parts comprehended in the foregoing* GENERAL DESCRIPTIONS.

J. Record sculp. 1787



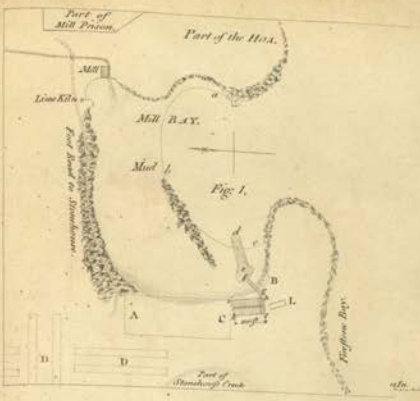


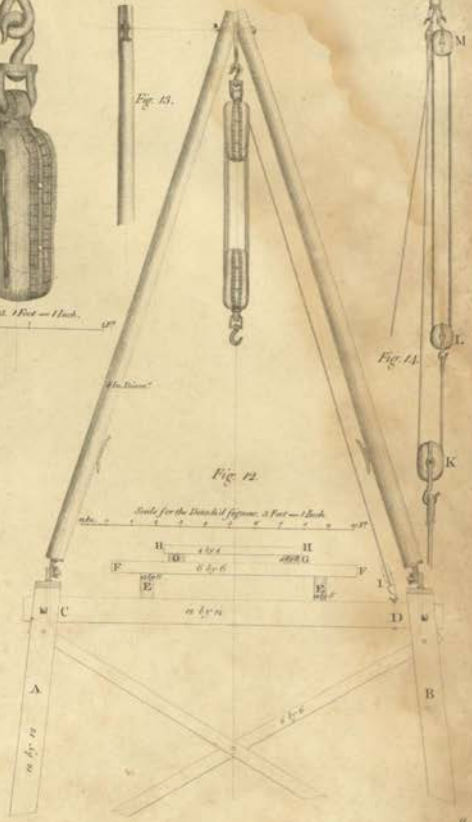


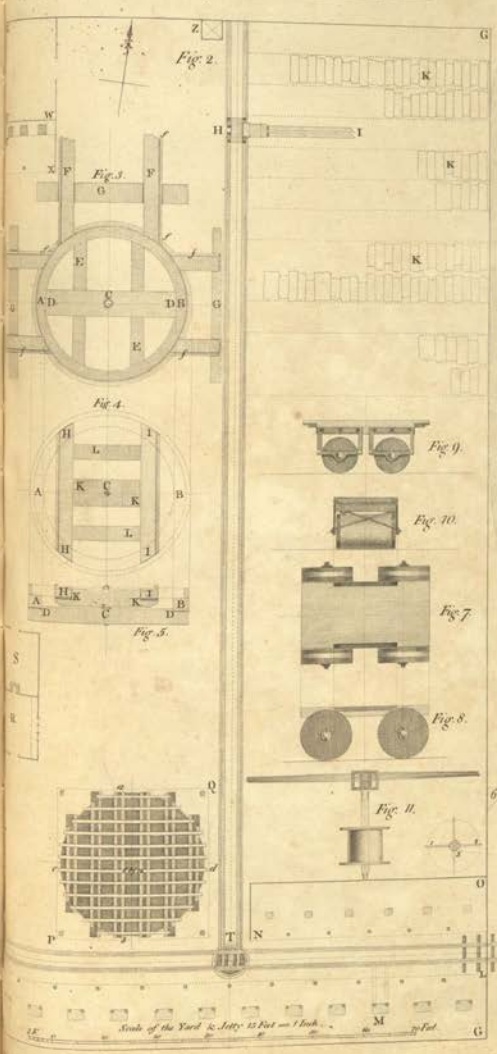


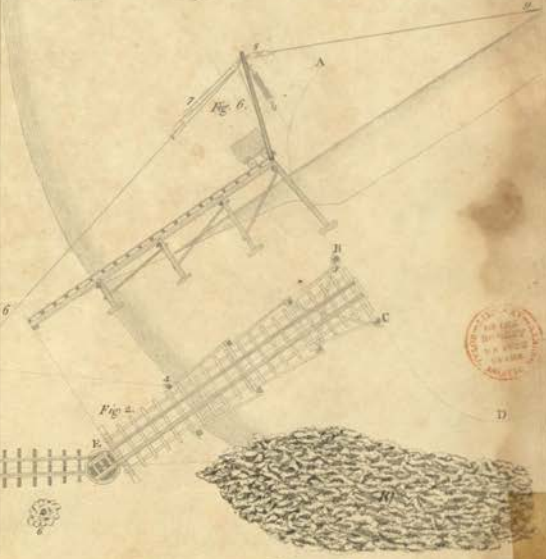
Mr JESSOP's DRAUGHT *by which the* YAWLS *were built for the* EDYSTONE SERVICE.

J. Record fculp. 1786







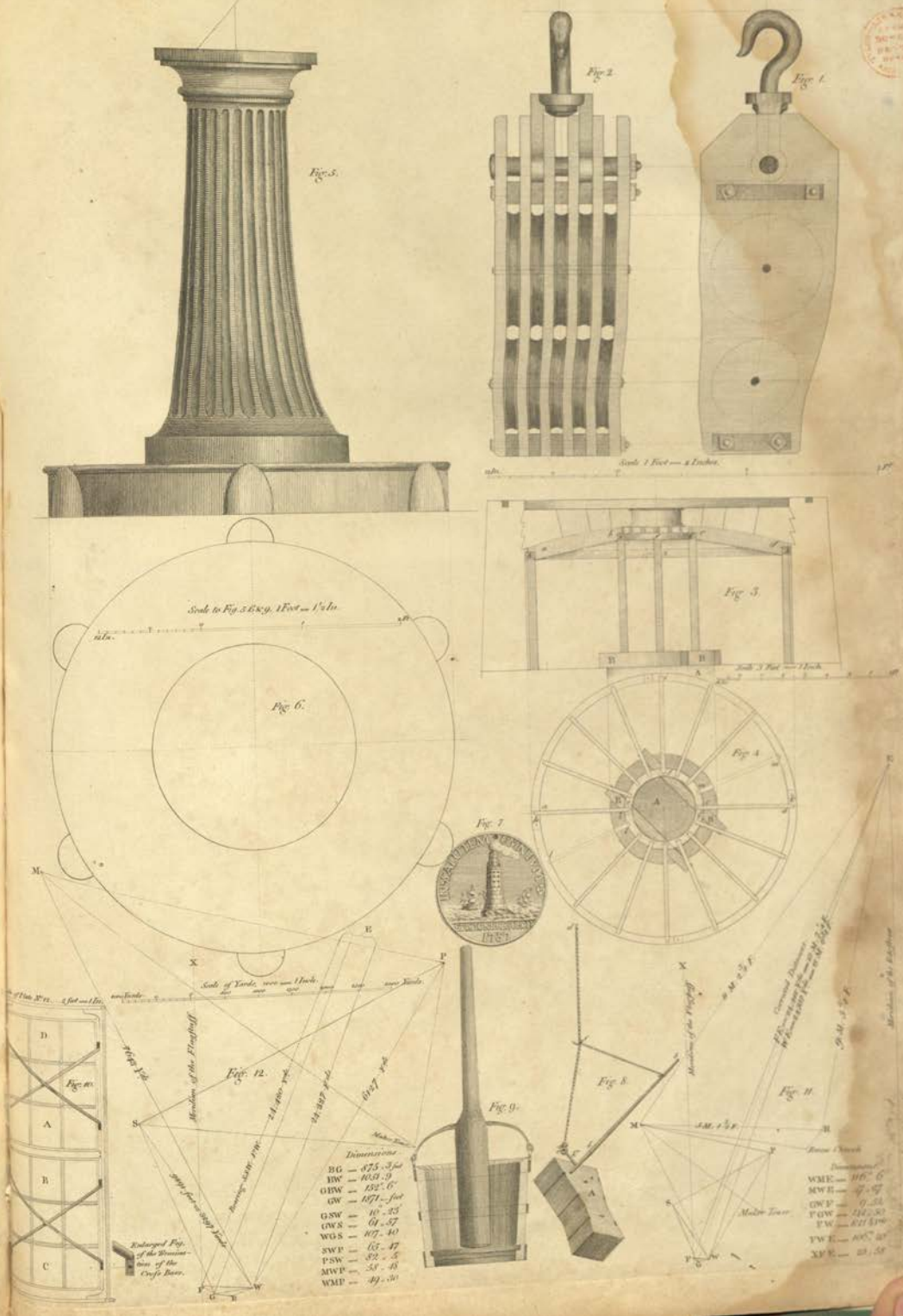


PLAN & DESCRIPTION *of the* WORK YARD *at* MILL-BAY *with its* FURNITURE & UTENSILS.

J. Record Sculp. 1788

Descriptions of SUPPLEMENTAL MATTERS *having reference to the* EDYSTONE BUILDING. No. 1

J. Record sculp. 1790.

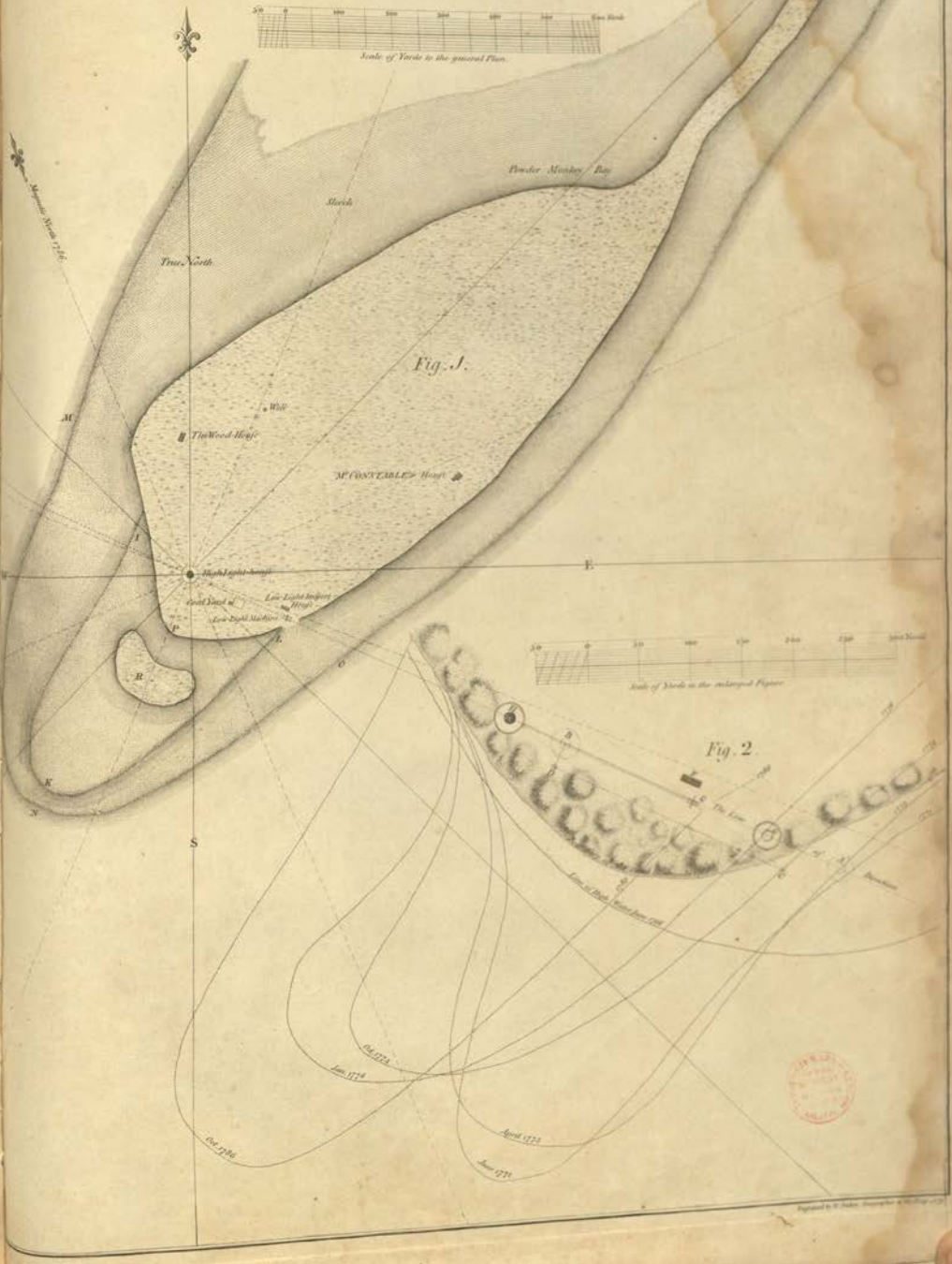


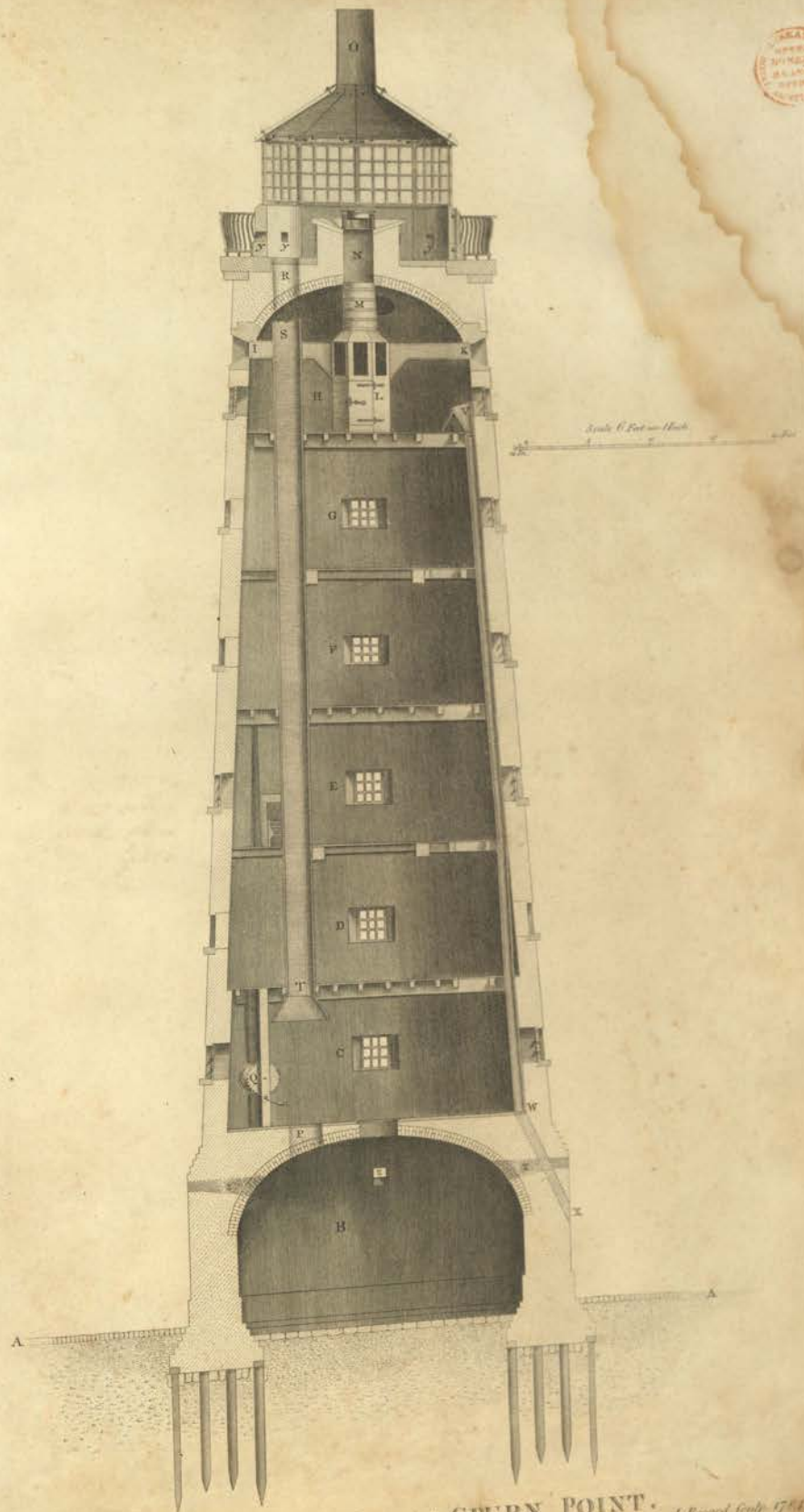
A MAP
of the COASTS & COUNTRY
near the
SPURN POINT.
PART OF
THE
GERMAN
OCEAN
YORK
PART OF
SHIRE
HOLDERNESS
PART
OF
LINCOLNSHIRE
RIVER HUMBER
FLAMBOROUGH HEAD
Flamborough
Bridlington
Bridlington Quay
Hilderthorp
Wilsthorp
Thornham
Fraysthorp
Skipsey
Bransburton
Hornsey
Headon
Pattrington
Barton
KINGSTON upon HULL
SUNKISLAND
SPURN HEAD
Grimsby
Glanford Bridge
Scale of Miles

PLAN

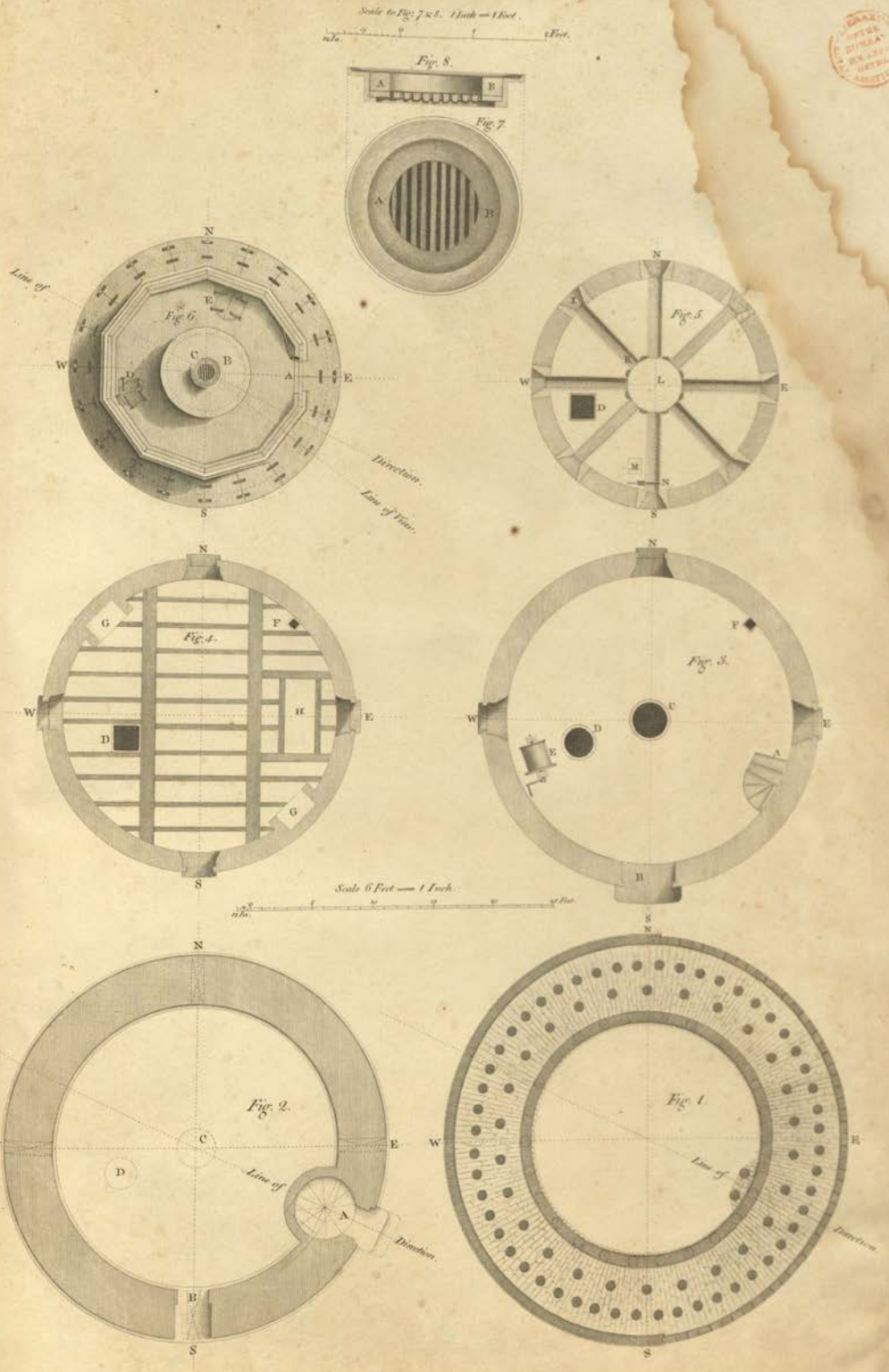
of the SPURN POINT, *as in 1786.*

Also its Variations, during the preceeding 20 Years.





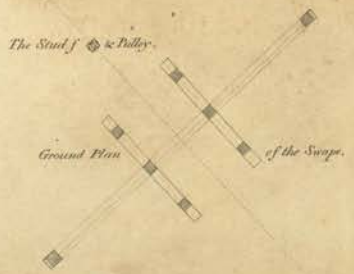
SECTION *of the* HIGH LIGHTHOUSE *upon the* SPURN POINT. *J. Record sculp. 1784.*

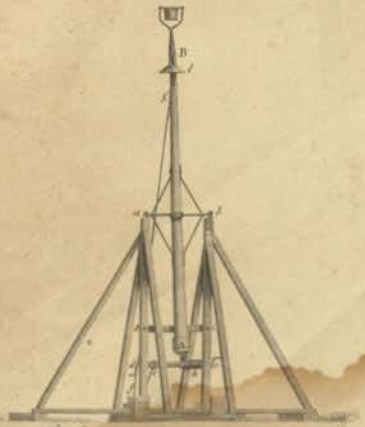


PLANS *of the different* FLOORS *applicable to the preceding* SECTION.

J. Record Sculp. 1763.

LIBRARY OF THE ... GRAND ... OFFICE





Scale 10 Feet — 1 Inch.

ELEVATION *of the* HIGH LIGHTHOUSE *upon the* SPURN POINT, *& of the* SWAPE *by which the* LOW LIGHT *is Exhibited.*

J. Record sculp. 1785.

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